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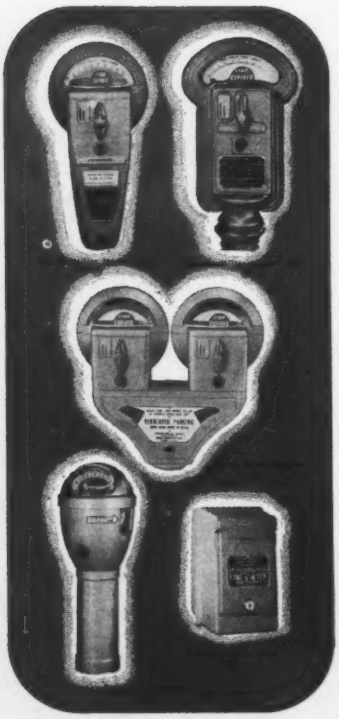

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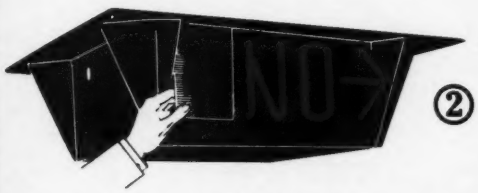

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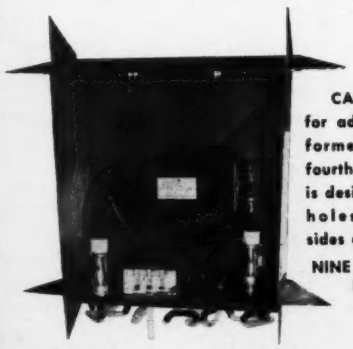

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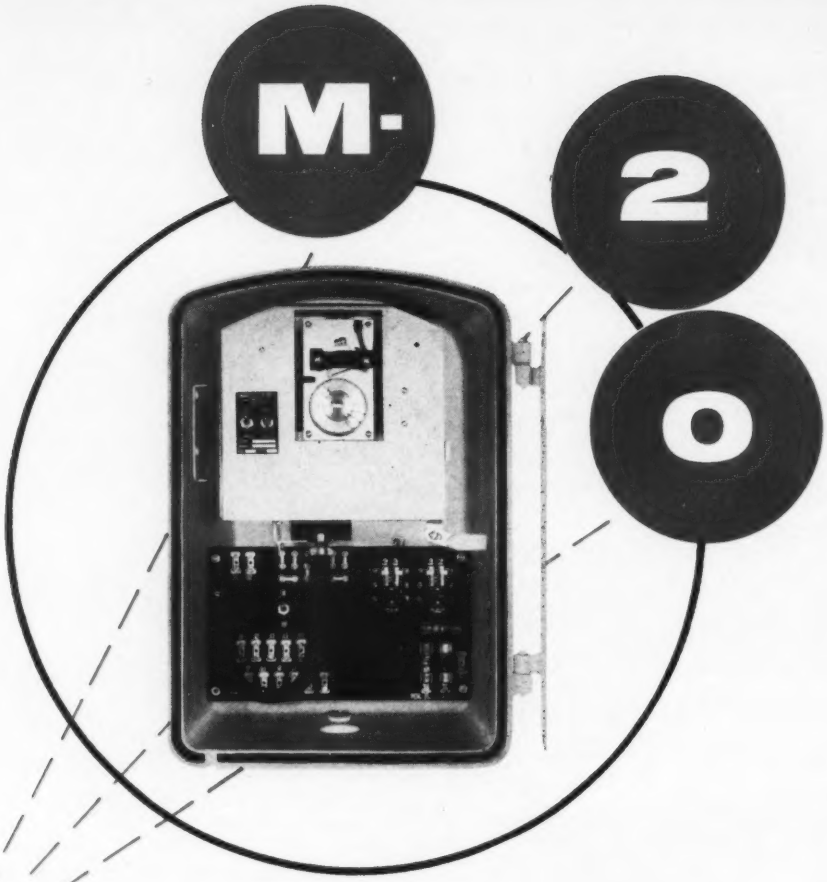

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OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

Vol. 28 MAY, 1958 Number 8

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COVER: An "S-curve" bridge near New Concord, Muskingum County, Ohio, preserved as a relic of an earlier day when life was more leisurely (and horsepower had something to do with horses!). —Photo courtesy of Ohio Department of Highways

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Frankly Speaking . . .

ALL MEMBERS OF THE INSTITUTE are privileged and encouraged to participate in technical committee activity. The technical activities of the Institute are the responsibility of the Technical Council, composed of the seven department heads with an Institute Vice President as Chairman, which serves as an agency of the Institute of Traffic Engineers Board of Direction with authority to direct and supervise all technical activities of the Institute subject only to the Board of Direction concurrence. The Technical Council has considerable latitude in its activities and depends entirely on the cooperation of the membership who serve on the several technical committees in the seven departments. The rules and procedures of the Technical Council are described on pages 39-41, inclusive, in the 1958 Yearbook.

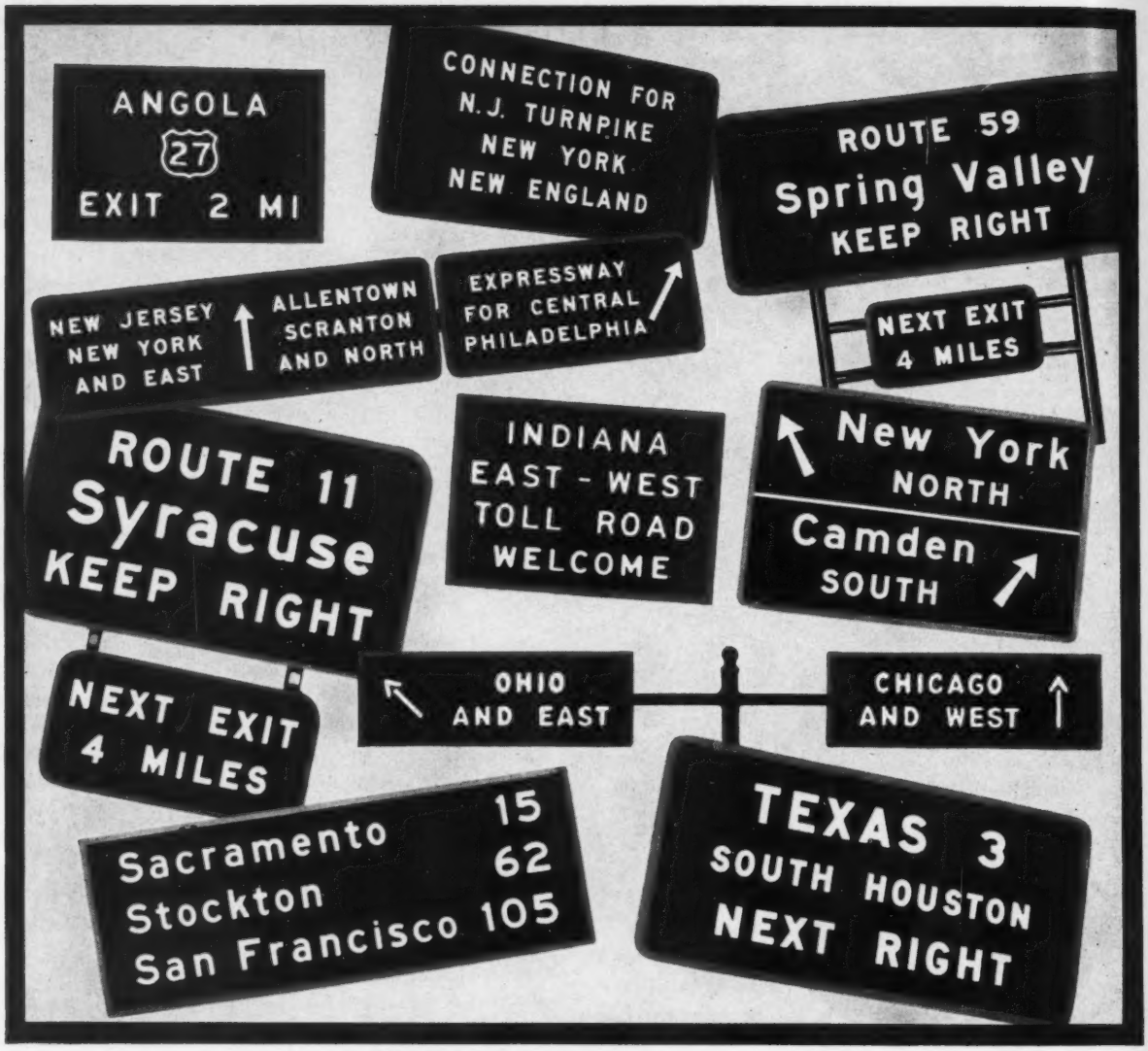
As Chairman of the Technical Council I have been very much interested in an active technical program in which the several technical committees would be engaged in pursuing research, developing standards, or warrants or the compilation of technical information of value and interest to all traffic engineers to the end that the results of committee work would be available in published form to all members. While several of the committees have been active, many have not produced anything. This naturally raises the question of whether our membership on these committees are interested in carrying out the responsibility assumed when they volunteered to serve. Our Technical Council roster lists 462 members on 40 committees in the seven departments. This is a good percentage of the entire membership. It would appear that with this large number who have indicated their interest by volunteering to serve on these committees, there should be more results to show for the ITE technical program.

The actual results of our Technical Council activities to date is far from what we should be proud of. This matter of the rather poor showing of our technical committees was discussed at the last meeting of the Technical Council. It was noted that several committees were actively pursuing toward completion certain assignments that they had had underway for some time, but a majority of the committees had failed to show much if any activity. If the fault lies in the Council, the committee chairmen or membership, we must be made aware of it. Constructive criticism is always in order.

There is a possibility that the general functions of the traffic engineer are changing somewhat from basic research to operation. We know that more and more the traffic engineers are responsible for traffic operations. At the same time to handle these day-to-day operations he must have the best tools at hand. These tools can best be determined by examining and evaluating the standards that have served in the past and making such modifications as are necessary to fit the changing traffic conditions that are or will be confronting the traffic engineer and the highway engineer with the continued development of the national interstate highway system. Our Technical Council is giving thought to the possibility of revising or realigning our technical committee activity to reflect the present and anticipated responsibilities which the traffic engineer will be faced with in handling the increasing traffic resulting from the current long range national highway construction program. We hope that our Regional Freeway Operations Seminars that are being sponsored and conducted by the Institute of Traffic Engineers in several areas throughout the country may produce ideas useful to our technical committees in pursuing activity of interest in line with actual operating problems in which we anticipate the traffic engineer will become involved. Before the next Technical Council meeting this summer we will have had the experience of two Regional Freeway Operations Seminars, one to be held in Columbus, Ohio, April 23-25, 1958 and the second in Sacramento, California, June 16-18, 1958. In the meantime the Technical Council is urging, through the committee chairmen, to again review their current and planned technical committee activity with the hope that at the next Technical Council meeting we shall be able to evaluate more effectively our present scope of activity and determine what, if any, changes should be made to assure active interest by all members who volunteer to serve on technical committees.

In discussing this matter editorially with our membership I am hopeful that our technical committee members through their chairmen and department heads will be able to offer constructive comments or criticism to assist the Technical Council in formulating a more positive and effective program of technical activity for the members of the Institute. Your whole-hearted cooperation in pursuing the technical committee activity to which you have volunteered will be sincerely appreciated.

EDWARD G. WETZEL, *Vice President*
Chairman, Technical Council



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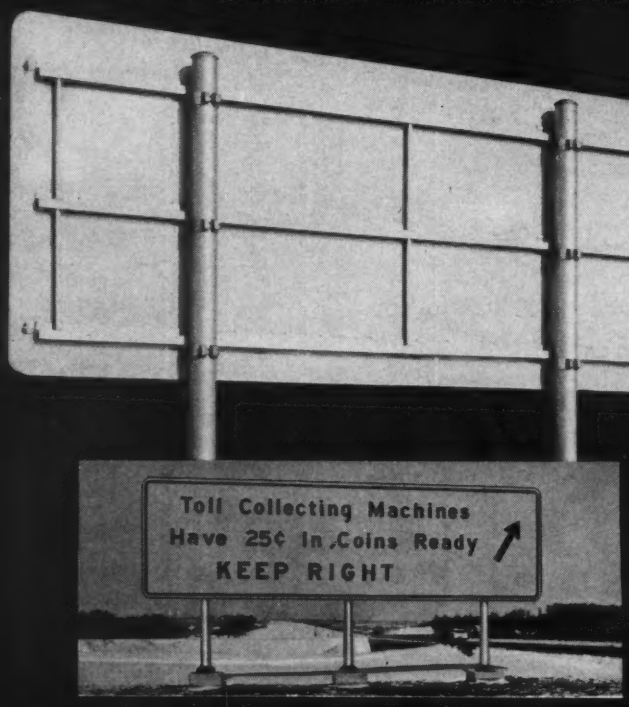

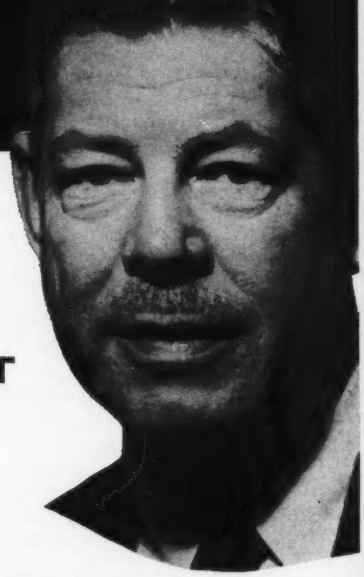

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The Role of the Traffic Engineer In Highway Safety

By T. T. Wiley
(Mem., ITE)
Commissioner of Traffic, New York City

BEFORE DISCUSSING the role of the traffic engineer in highway safety, we should clear up an important detail —namely, what is traffic engineering. The Institute of Traffic Engineers defines traffic engineering as that phase of engineering which deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

This is a rapidly growing branch of the engineering profession. There are now over 1,100 members of the Institute of Traffic Engineers, which is a national professional society with the same membership requirements as the founder engineering societies. Today's traffic engineer must meet the same standards of education, training, experience, and high standards that apply to other professions.

Having defined the profession, note the objectives — safety, convenience, and economy in transportation. It is not by chance that safety is given first. That is where it belongs, and that is where responsible traffic engineers place it. Fortunately, safety, convenience, and economy in transportation are so related that *correct* action to achieve safety usually brings about convenience and economy, and vice versa, so that none of these objectives need be sacrificed for the others. More on this point later.

Note that the traffic engineer functions in the fields of planning, design, and operation. Planning and design are obvious engineering functions.

For many years, the traffic engineer has been making traffic surveys for planning purposes. Way back in 1931 the Illinois Division of Highways pioneered the way with a state-wide traffic survey of its highways in which, incidentally, I had the opportunity to play a responsible role. Since then, great strides have been made in traffic engineering studies so essential to planning street and highway programs to provide safe, convenient, and economic transportation.

Proper design of streets and highways is essential to safe operation. Here is another role for the traffic engineer which, unfortunately, has often been ignored or overlooked. Design of streets and highways has too often in the past been undertaken with little knowledge or attention to the problems of operation. Not until the operating traffic engineer began to experience and to point out the factors that caused accidents, congestion, and other traffic difficulties, did the importance of providing for these factors in the design stage become apparent. Today, in enlightened design offices traffic engineers do the geometric design or check it. Hence, the traffic engineer is more and more in a position to do his part to achieve safer highways as affected by cross-sections, grades, curvature, merging and weaving sections, roadside control, medians, and other design features. However, I must point out that too many street and highway improvements are still being built containing shortcomings in design resulting in unnecessary accident hazards and other operational difficulties.

With the foregoing brief references to the traffic engineer in planning and design as related to safety let's move on to the activity where he now plays his biggest role, — the operation of streets and highways.

In the early days, the responsibility of controlling traffic fell naturally into the responsibilities of the police. However, as traffic increased, many problems developed that were beyond the scope of normal police work. Because the highway system is an engineering structure, which requires the engineering approach to appraise operating problems and engineering techniques to solve them, the traffic engineering profession evolved and the traffic engineer took his place alongside the enforcement agencies in providing safety in traffic movement.

Many persons still wonder what is so mysterious or difficult about a safety problem that you must have an engineer to solve it. Why not just put in a traffic signal or a "Speed Limit 15 mph" sign? It is a standard joke in our profession that the number of traffic engineers in a city is equal to the population. Everyone is a traffic expert. But, believe me, this attitude is in itself one of the great accident hazards because the public holds many false theories on traffic safety and through pressures and misguided officials is often in a position to put these theories into effect. Let me illustrate a few examples.

A theory generally held by the public is that a traffic signal is the best means for protecting children at school crossings.

Several years ago, an analysis was made of accidents over a three-year period, involving children in the 5-14 year age group, at 40 intersections in a large city. These intersections were divided into four groups of ten each. The selections were made so that traffic conditions were comparable and the only significant differences were that during school crossing hours, Group 1 was supervised by school patrol boys, Group 2 by patrol boys plus school janitor, Group 3 by patrol boys and police officer, and Group 4 by patrol boys plus traffic signals. The facts showed the fewest accidents occurred at Group 1, next fewest at

An address delivered before the Illinois Editor and Publisher Traffic Safety Seminar held at Peoria, Illinois, January 10, 1958.

Group 2, followed closely by Group 3. The differences between these three groups were quite small and within the laws of chance. But, at the ten intersection in Group 4 "protected" by traffic signals, there were more than twice as many accidents involving the 5-14 year age group than at all 30 of the other crossings combined. The facts indicated that the chances of accidents with signals was about 7 times greater than without signals. Not only is the public's theory wrong, but its application can and has led to accidents which traffic engineering could have prevented. The experienced traffic engineer knows and understands the circumstances under which a signal will be of value or a hazard. The layman does not. Whose judgment would you trust for your child's safety?

The public often advances the theory that it will be much safer to cross a street if traffic is forced to stop. Here is another theory often at odds with the facts.

A major thoroughfare in one of our larger cities was being operated at top efficiency with a signal system set to provide for inbound and outbound rush periods, a reversal of the centermost lanes to favor peak movements, and other features. The street carried a very heavy flow of about 55,000 cars per day at an average speed of above 20 mph in rush periods and near 30 mph in off-peaks. Traffic moving along the artery made about 400,000 stops per day at the signalized intersections. It was not easy for pedestrians to cross except at the signals and they were vociferous about it.

Over the strong protests of the traffic engineer, the administration ordered the operation changed to the block system requiring a stop on red at the nearest intersection. This means that all the signals controlling traffic moving along the artery changed to red at the same instant and that all drivers were required to stop at the nearest intersection when the signal ahead was red. As all traffic was required to stop at once, the street became easy for pedestrians to cross. Their complaints ceased. Traffic volumes dropped from 55,000 to 40,000 cars per day because of the inconvenience of the frequent stops. Actual driving speeds increased, but average overall speed decreased because of more stops and delays. The number of stops rose to 888,000 per day.

Now, the purpose of stopping all this traffic was to reduce accidents and make it easier to cross. How well did it succeed? A check of accidents over comparable periods before and after the change was revealing. During the "before" period 53 accidents occurred. As the number of stops increased to 880,000 from 400,000, the number of stopping acts required by drivers increased in the ratio of 2.2 to 1. Apply this ratio to the 53 accidents that occurred before the change and 116.6 is the result. How many accidents occurred after the change? 117. Thus, the number of accidents went up in exact ratio to the number of stops. And, although the pedestrians thought the new system just great, 30% more of them got hit.

This points up another false theory under which the public confuses *ease* in crossing with *safety* in crossing. The two are not the same and may be diametrically opposed, as in this instance. The changes made did not bring about safer, more convenient, more economical transportation. Instead, accidents sharply increased, over 20% of the traffic was so inconvenienced as to seek other routes, and that portion of the economic loss measured by gasoline burned up per year in unnecessary stops was in the hundreds of thousands of dollars.

Earlier I pointed out that safety, convenience, and economy usually went hand in hand. The above experience illustrates the point. When a street is operated efficiently, it will operate at the highest level of safety. When smooth flow is interfered with accidents will go up.

This fiasco is a classic example of the difference in results when decisions on traffic operations are made by well-intentioned but uninformed officials or by professional traffic engineers. Who do you think should be given the role?

Let's get down to a simpler example. A school crossing looks a little difficult for children to cross. Parents demand a STOP sign to halt traffic. Of course, this means that a vehicle which was a problem for 3 or 4 seconds while approaching and passing the intersection, is now a problem for 10 to 15 seconds. It means that a situation of indecision is created as to when to cross as a pedestrian or when to start as a motorist. It means that normal gaps in traffic through which crossings can be made in complete safety are closed up. Under such control, an intersection that wasn't busy before now looks like a major intersection. It isn't — it just looks it. It doesn't even look *safer* — and it usually isn't. Is this the right approach to the problem? Who should have the role of deciding what is the safest way to operate the intersection, the parents or the engineer?

Let's change pace again — and talk about speed and speed limits. Here again is a subject on which there are many illusions — or is it delusions. It is certainly in the state of *confusion*.

Perhaps one reason for this is the belief on the part of the many that the mere posting of a speed limit at the rate which they would like to see traffic operate will bring about such operation. Research conducted by the University of Illinois shed light on this. A test section of a city street on the approach to a school was posted at 25 mph, 35 mph, 20 mph, and no limit. Speeds were checked under each condition. The results were essentially identical under each regulation. Research in other states has given similar results. It is the highway itself and traffic conditions upon it that determine speeds of operation, not a sign establishing an arbitrary or unreasonable limit.

It was my assignment some 20 years ago when working for the Illinois Division of Highways to compare accident records and speeds on a number of the principal highway routes. The results were illuminating. Some highways with high average speeds had a lower accident rate than some highways with lower average speeds. It was found that the highways that had the greatest *differentials* in speeds — not the highest average speeds — were the ones with the highest accident rates. In other words, when a highway carries vehicles moving at various speeds, overtaking and passing becomes frequent and this type of very serious accident occurs in high numbers. It is a well-established principle in traffic engineering that when all traffic is moving at the same speed, there will be a minimum of accidents. Yet there are a number of states which by law set up different speed limits for different classes of vehicles using the same highways. This is directly contrary to this established principle for safe operation.

The public sees only the surface of things—the symptoms of a problem. The public does not have the training, the background, the experience, nor even the desire to dig underneath these

symptoms to find the real problem and the best solution. Yet, the public will move blithely ahead into faulty diagnosis and fatal action and never blink an eye nor recognize that things have gone wrong.

If you had a boy who showed up with a severe, persistent rash on his arms you would take him to your doctor. You could demand that the doctor cut the arms off, which would take care of the rash, but you wouldn't do that. You might suggest antibiotics, and if he didn't take umbrage at having you tell him his business and throw you out of the office, he would likely say that the trouble must be located before treatment can be prescribed. A few questions may disclose that the boy has been eating too many strawberries. The boy may grumble at giving up strawberries, but the rash disappears. Or maybe, it is a case of poison ivy for which a prescription is given. Incidentally, the treatment will be different than that which you used for your poison ivy when you were young. It is the doctor's business to keep up to date on developments in his field. He does that, while you can't and don't. Perhaps he can't reach a quick decision. He wants X-rays, blood counts, and other facts before he makes a diagnosis. In order to eliminate the real trouble for which the rash is a symptom, radical measures may be necessary which will upset you greatly. But, you will see that they are taken, because you acknowledge that the professional judgment of the doctor offers the best chance for preserving the health, perhaps even the life, of your youngster.

There is a direct analogy between the acts of the doctor and those of the traffic engineer. The role that the traffic engineer plays in protecting the users of the streets and highways from traffic accidents is the comparable role to that of the medical profession in protecting the health of the public. It is the role of the trained professional. He looks at the symptoms, he makes traffic counts, analyzes other facts, he conducts research, he studies what the other professionals are doing and what results they have achieved. In short, he brings to bear upon the problem of street and highway safety the scientific and engineering principles, the experience, the training, and the professional judgment of a person whose career is devoted to protection of life and limb on the highways.

Who, then, should make the decisions as to what to do with respect to the operation of the highway system? The answer should be obvious. Just as the doctor's decision is accepted with respect to a health matter — even though the medicine may be bitter or the needle hurt a little bit — so should the professional decision of the traffic engineer be accepted and carried out.

How is the traffic engineer to carry out this important role?

The traffic engineer has at his hands many tools. Traffic signals, guide and warning signs, pavement markings, safety islands, one-way operation, control of turns, regulation of curb use, and other measures can be used. But, having reached a decision, how can he put it into effect?

The degree of authority resting in the traffic engineer varies widely throughout the nation. On state highways, for example, the highway department can usually do those things that are required to operate the highway safely. But when you move from state to local level, the situation is quite different.

In most local communities, regulation of traffic is looked upon as a legal matter and is handled by a local ordinance or resolution adopted or rejected by the local legislative body. I need not point out to you in any detail that, in many instances, this means that actions taken are often based upon local pressures or for political advantage and not upon the real merits. Furthermore, highly essential action may often be defeated.

The traffic engineer is not in the same position as the doctor who tells the patient what to do. Instead, far too often, the patient tells the traffic engineer what to do.

I submit to you that this is not the way to lick the accident problem. Pressures and politics cannot be permitted to dictate action. If all available means are to be used to reduce the terrible toll of accidents on the streets and highways, the decisions of professional educators, enforcement officials, and engineers must prevail.

Most of such decisions are basically administrative in character—not legislative. State legislation should spell out only the basic requirements that motorists and pedestrians must meet. State law, for example, should set forth the basic rules of the road, such as pass to the right, and require obedience to all traffic control devices. From that point, state and local laws should convey upon the proper professionals the responsibility and the power to utilize the professional tools in their hands to carry out their decisions directly, instead of submitting recommendations to others and engaging in long debates and suffering long delays, not to mention overruling, as is the case in many instances under present procedures.

Some of us are fortunate enough to have such powers to carry out our decisions. Others have them to some degree. But most do not have them at all.

If the traffic engineer is to carry out his role for operating the streets and highways safely and efficiently he must be given the power, as well as the responsibility.

I'm sure there is a question which has occurred to many of you. Many local governments don't have traffic engineers, so how are they going to get professional decisions? I wish I had the answer to that, but I do not.

The field of traffic engineering, as is the case with much of the engineering profession, is suffering from a grave lack of trained, experienced engineers. I see no possibility that this shortage will end within the next few years. Yet appalling mistakes are being made, particularly in the suburbs of our larger cities, because engineering services are not available. The least that could be done would be to assign the responsibility for traffic control to some one in the city engineering office or other engineering office. If he has talent and a liking and interest in the assignment, his decisions will average out much better than those made by others.

Let's sum up.

1. The traffic engineer is a professional engineer whose objectives are safe, convenient, economical transportation.

2. The traffic engineer functions in the field of planning, design, and operation of the streets and highways.

3. The public holds many false theories on safe operation. I gave you typical examples.

4. Just as the doctor protects the health of his public by drawing upon his training and his experience, plus the research and knowledge and de-

(Continued on page 48)

Policies Affecting Interstate Design

By Joseph Barnett
Deputy Assistant Commissioner for Engineering
U. S. Bureau of Public Roads
Washington, D. C.

SECTION 108(i) of the Highway Act of 1956 calls for geometric and construction standards for the Interstate System which are to be approved by the Secretary of Commerce in cooperation with the State highway departments, and for the Secretary to apply such standards uniformly throughout the States. The standards prepared by the Committee on Planning and Design Policies of the American Association of State Highway Officials were adopted by the association and accepted by the Commissioner of Public Roads for use on highways financed with Federal Aid Interstate funds, all within a few days of the passage of the act. Such quick action did not, however, indicate haste, for the committee and AASHO had been working on and developing these standards for several years.

For an undertaking as great as the development of the National System of Interstate and Defense Highways the standards are indeed brief, for they are limited to basic requirements. Their use will insure adequacy for future traffic needs and encourage uniformity between the States. Such uniformity, however, does not mean the same dimensions for the same type of highway for all the States. Our country is too vast and the different traffic and other needs combined with the variation in conditions, physical and otherwise, are bound to result in considerable leeway in the design of highways, particularly since the standards are minimum in character and dimensions above minimum are highly desirable. Conditions in one State would enable higher values to be attained with very little extra cost. In another State where above-minimum values will require expenditure out of keeping with the benefits obtained, minimum or near minimum values are acceptable.

There is now nation-wide acceptance of the principle of planned access control to insure safety of operation, increased utility and maintenance of capacity, but it has been a long struggle, extending over more than a quarter of a century. Perhaps motorists in New York and other States, who have for so many years observed the benefits of access control, may not appreciate the difficulties in selling this fundamental concept of good design for arterial highways.

Although control of access is generally required on the Interstate System the standards provide that under extraordinary conditions and where a grade separation would not be in the public interest, crossings or entrances at grade are permitted through agreement between the State highway department and the Secretary of Commerce. The thoughts behind this clause, permitting such exceptions, are that there are locations where a grade separation or any other means of providing access, such as by use of frontage roads, is neither favorable nor desirable under the particular conditions.

The conditions in actual practice under which this exception has been approved have varied. In one case there is a primitive road leading to a radar station which might be examined once a week. This road is permitted to enter the highway, and a locked gate is provided. There are cattle ranges through the West measured in square miles rather than in acres, in which entrances from the property might result in traffic of perhaps three or four vehicles per day. There was one project in the State of Washington which we recently surveyed and found entrances with volumes ranging from six to ten per week. Public roads with somewhat higher volumes have in a few cases been permitted to enter at grade on a temporary basis as stage construction with the proviso that enough right-of-way is purchased so that the grade crossing can be eliminated in the future.

These exceptions were permitted because their effect on through traffic, which usually in such areas is well below capacity, would be nil. Control of access between entrances is required, of course, and in many cases the entrances are controlled by locked gates. The situations outlined are generally found only in the sparsely settled areas of the West.

Now that the standards have been in operation for nearly two years and many miles of Interstate highways have been designed and put under construction and many miles of right-of-way purchased, there are problems arising in which values for the guidance of designers and for insuring uniformity between States are desirable. The Executive Committee of the American Association of State Highway Officials refers many of these to the Association's Committee on Planning and Design Policies, and in due course policies for the guidance of Interstate highway designers will be forthcoming. I thought you would like to learn of some of the subjects under consideration at this time and what our present thinking is, but before doing so we might discuss two items on which the work of the committee is completed and policies have either been approved or are nearly ready for letter ballot of the States.

Safety Rest Areas

A policy of the American Association of State Highway Officials on safety rest areas shortly will be avail-

An address before the Conference of the New York State Association of Highway Engineers on March 27, 1958 at Rochester, N. Y.

able for guide purposes. While this brochure has considerable discussion regarding safety rest areas and illustrations showing examples of design, the policy portion of it, on which the States letter ballot, is deliberately limited in scope. It calls for rest areas to be provided on Interstate highways as a safety measure, separated from the through traffic roadways, with high type entrances and exits, including acceleration and deceleration lanes, parking areas, benches, and tables. Toilets and water supply are permitted where proper maintenance and supervision are assured. They may be designed for short-time picnic use in addition to parking of vehicles for short rest periods, but they are not to be planned for use as local parks, leisurely picnics, active recreation, water-front activities, or over-night camps.

There is a discussion on the location and spacing of sites, their size, factors in site selection, layout and design. The safety area is to be entirely within the control of access lines so that it serves its purpose of providing spaces to rest for travelers on the Interstate highway only and is to be limited in size so that not more than about three acres may be developed. National, State and local parks are not considered to be part of Interstate highway development.

Frontage Roads

The matter of frontage roads has been a vexing problem in the design of Interstate highways, particularly with regard to uniform application between the States, but the American Association of State Highway Officials has now published a policy guide on this subject.

Where an existing highway is converted to a freeway there usually is no problem. It rarely is economical to purchase existing access rights and it is best to convert the existing roadway to one frontage road and restore access on the other edge by constructing a second frontage road.

Freeways on new location pose the problem. Some States operate under legislation or under judicial decision by which highways on new location can be developed without frontage roads and no damages need be paid for controlling access. Such authority is based on the fact that since no highway exists when the right-of-way is purchased the land owner has no access to a highway and it is, therefore, not possible to purchase a non-existent right of access. Despite this logic, damages to remainders or severance damages often reflect such non-existent damages. Since judicial decisions have been reached in only a few States lawyers generally favor statements in the deeds controlling access, paying for them if necessary. Highway departments in many States have limited powers in this direction, requiring the actual purchase of access rights on such highways.

Some States feel that even when on new location parallel frontage roads are required. As a result, some States are thinking in terms of little or no frontage roads, and others in almost unlimited mileage of frontage roads. The AASHO and the Bureau of Public Roads have taken the position that where a highway is on new location, frontage roads per se are not to be provided. They may be provided, however, in short lengths when they are necessary and it is deemed economically advantageous to restore local circulation by connecting a cut-off local road or street with another road or street which crosses over or under the Interstate highway.

Such frontage roads are not necessarily limited to those parallel to the through traffic roadways and constructed on the Interstate right-of-way or adjacent thereto. Where justification can be established there may be advantage in providing a frontage road somewhat removed from the Interstate right-of-way to restore local circulation and gain the benefits of land service on both sides of the frontage road.

Service Stations

In the preparation of the AASHO frontage road guide the matter of services to motorists on the Interstate highway had to be considered, and areas where such services might be available are shown in the illustrations for typical treatment of frontage roads. They generally are along the cross-road or street which has interchange with the Interstate highway or along frontage roads which are adjacent to the Interstate roadways and which are accessible for Interstate traffic through the normal design for interchange.

Section 112 of the Federal Aid Highway Act prohibits the development of automotive service facilities and other commercial establishments on the rights-of-way of Interstate highways. The Congress enacted this section with full knowledge of the difficult administrative problems which would develop if private businesses were permitted on the rights-of-way of Interstate highways as well as the desirability of conserving the investments in existing roadside businesses by avoiding competition therewith.

Many persons are concerned that travelers on Interstate highways will not be properly serviced and expect difficulty in having vehicles run out of gas. They also fear that the function of gas stations in providing comfort facilities will be missed. Opinion has also been offered that drivers in leaving the Interstate highway at interchanges to obtain services, will subject the local and State highways on which the service facilities will be located to undue traffic loads.

The matter of service to motorists on controlled access highways has been under discussion for many years. The experience of toll roads which provided gas stations on their rights-of-way both as service to the public and as a revenue producer is well known. The lack of congestion on the crossroads which have interchange with the toll roads has been attributed to the presence of those service stations. It should be realized, however, that interchanges on toll-free controlled access highways would be more closely spaced than on toll roads. The State highway departments can readily design the interchanges and the crossroads at such locations so as to provide adequately for the traffic which would leave the Interstate highway and proceed to the crossroads for service such as that provided by gas stations.

Several States and representatives of commercial firms and of the road users have expressed interest in revising the law to permit service stations on the rights-of-way of the Interstate System. Any recommendations at this time would seem to be premature since there has not as yet been enough experience with the operation of toll-free controlled access highways of appreciable length to have factual data regarding the effect of Section 112 of the Highway Act. It is expected that within a few years numerous sections of the Interstate System with control of access continuous over relatively long sections will be in operation. At that time, it will be possible to observe

whether private enterprise has solved the problem of serving motorists and how the road users generally feel about it.

It is of interest that the American Petroleum Institute is not overly concerned with the omission of gas stations on Interstate highways. They feel that the law as written will better protect the gas station owners on existing roads and feel that where such is lacking, adequate facilities will doubtless be established on intersecting roads.

It should also be realized that Interstate highways will be adequately signed and drivers will be directed to those roads and streets with available facilities to serve the motorist.

Signing

A special committee of the American Association of State Highway Officials has done some research on signs for Interstate highways, and the Association's brochure establishing a policy on signing has been approved by the States. It is clearly the intent to restrict signs on the Interstate highway to those necessary for the safe and expeditious operation of traffic. We have had requests for permitting signs on Interstate highways for various purposes, all of a highly commendable nature. Two such requests concerned historical markers and signs indicating soil conservation districts. The matter of historical markers was discussed by the AASHO Committee on Planning and Design Policies, but the committee did not wish to prepare a policy at this time.

The present thinking of the Bureau of Public Roads follows: Travel on Interstate System highways is likely to be at relatively high speed. For safety, signs must have large letters and the message will have to be simple. Signs will be justified only for important messages such as warning and direction signs to interchanges and other justifiable turnouts. While we are sympathetic to the amenities which would include leisurely driving, time for reading historical markers and inspecting the area, it does not seem to us to fit in with the concept of through travel on the Interstate System. A separate turnout for stopping at an historical marker does not seem to be justified. Such a turnout would have to be equal in every respect to any other turnout; that is, have long acceleration and deceleration lanes, advance warning and turnout signs, and with places to stop separated from the through traffic lanes and shoulders.

I have previously discussed the AASHO policy on safety rest areas. Rest areas will be reached by roadways designed for safe ingress and egress. They will have parking spaces for vehicles and may, in addition, have sanitary facilities. It would seem that if a safety rest area is justified at a location of an historical marker, a happy solution would be provision for both.

This does not in any way detract from the desirability of such signs nor from the fine work being done by such agencies as Soil Conservation Districts, but if signs are permitted for indicating the presence of such districts there is no limit to the signs which can reasonably be expected. Many local and quasi-public agencies, all doing excellent and highly commendable work, would doubtless like to have similar signs. Furthermore, it may well be that the first few signs which are not traffic signs will not seriously affect the utility and safety of the highway at first because it will be operating well below capacity. If, however a State highway department once starts granting permits for signs the highway would soon have many more signs which would become serious impediments to safety and traffic flow in later years as the volume approaches the capacity of the highway.

Police and Maintenance Facilities

The AASHO Committee on Planning and Design Policies is in agreement that direct entrances to the through traffic roadways from policing and maintenance facilities should be avoided for several reasons, one being that such entrances could not be denied to roadside businesses and the general public facilities unless public officials are similarly denied access.

For safety and flexibility, police and maintenance facilities should be located on crossroads which have complete interchange with the Interstate highway. Such a location would make the facility accessible to workers and the vehicles of others from all directions. It would increase safety and utility of the Interstate highway by restricting access to the well-designed entrances and exits of the interchange and eliminate the need for cross-overs or U-turns. It would be possible to sign crossovers to discourage their use by the general public; however, it would be very difficult to enforce such regulations. The very workers in the police post or similar facility would pressure for free direct crossovers.

Facilities such as police patrol posts and maintenance yards are in an entirely different category than safety rest areas. Rest areas will serve one-way occasional traffic, while patrol posts and maintenance facilities will frequently need road access for vehicles in both directions entering and leaving.

Recently we received inquiries regarding tourist information stations at State lines. Such stations could not very well function unless there is direct access to the through traffic lanes of the Interstate highway, and we in the Bureau have taken the position that if considered equivalent to a safety rest area and designed in a similar manner to insure safe ingress and egress they could be permitted if controlled and supervised in the same manner as a safety rest area. There naturally would be only one on each side of a State line, and that for entering traffic only. All but the tourist information building and allied facilities themselves could be legitimately considered for highway purposes.

Lighting

Many miles of the Interstate system doubtless will have fixed source lighting. It is unfortunate that we do not have a sound basis for justifying fixed source lighting. State highway administrators are hard headed business men, as they should be to carry out their public trust, and they must be convinced that an investment in lighting will bring a fair return to the public. The investment is large. Minimum values are $40,000 per mile for first cost and $4,000 per mile per year for maintenance and operation, but these figures are challenged as too low by many who claim they should be doubled or tripled.

The return on this investment is made up of several forms of benefit to the public. Intangible benefits are possibly greater use of the highway at night, some increased ease of policing, pleasing appearance and greater comfort in night driving, although many challenge the last benefit. The tangible benefit is reduction in accidents. Unfortunately there are no data

on accident experience at night comparing similar controlled access highways with and without fixed source lighting. The literature is replete with such data for streets and highways without access control where the value of lighting is justified anyway because the intangible benefits are so great.

Bear in mind that a properly designed highway on the Interstate system has no pedestrians, no crossings at grade, a wide planted median so that headlight glare is minimized and adequate shoulders so that few vehicles will ever stop on a through-traffic lane. There may be justification for lighting at interchanges and in densely populated areas where interchanges are frequent, vandals or children may roam across the highway despite fencing, and contrast with lighted streets may be objectionable; but until data on accident experience are available we are dealing with conjecture.

Fencing

The AASHO Committee on Planning and Design Policies is preparing a preliminary discussion on fencing the Interstate right-of-way. The present thinking is about as follows.

There appears to be no justification for constructing a fence which has no other function than to show the limits of the right-of-way on the ground. The right-of-way could be much more economically shown by markers or delineated by recorded maps showing the right-of-way limits in relation to the center line or edge of the nearest roadway pavement, or indicated by other means which are acceptable and customary in a particular area.

The toll roads have generally fenced their right-of-way, and in many locations fences present a picture of obvious waste as they run through swamp or other impassable places. It may be that their charters or agreements with bonding companies, or other requirements, made it necessary for toll road authorities to indicate the boundary by a line fence.

There are many places in the United States where a fence is objectionable. Often the farmers on adjoining lands are permitted to enter upon the highway roadsides and mow them, resulting in lower maintenance cost for the State, improved appearance of the roadsides, and some benefit to the adjoining land owners. Where a farmer abuses such privilege and creates hazard by crossing the road instead of using interchanges or machinery underpasses, he is soon found out. Warnings generally are sufficient to correct the situation. If not, more drastic measures become necessary, but there is no point in anticipating such misuse of the privilege.

A stock fence is in a different category from a right-of-way fence. It may well be that much hazard is created by allowing stock to roam and it will be necessary in many locations to construct a stock-proof fence to minimize this hazard. Where a farmer is paid to move a fence or construct a new one, it will be up to the State to see that this is done within a reasonable time. If the adjoining land owner pockets the money instead and the hazard of stock wandering on the right-of-way develops, the State may find itself in a position of being forced to provide the fence even though it had previously paid for it. Avoidance of double payment could be effected by either withholding the funds until the fence is erected by the farmer or by not paying for the fence and the State undertaking the erection. In the latter case, the State could very well find itself with the obligation of maintaining the fence, which is no small item of cost. The fact that the laws of a particular State place the responsibility for accidents caused by wandering stock on the farmer will not change the situation. If hazard develops the State will find itself duty bound to provide the stock fence whether or not it has previously paid for it even though the responsibility for accidents rests with the farmer.

A strong fence such as a link-chain fence is costly in both first cost and maintenance. It may be necessary in some places but its use should be kept to a minimum. In rural areas such fence may be justified to prevent wild animals crossing the highway. An example is high fencing to restrict deer. The location and design of fencing to control wild animals is not a simple matter. Conservation and the habits of wild animals cannot be ignored. Wild animals cannot read nor have we learned to communicate with them otherwise except by shooting at them. Research, trial and error and the cooperation of conservationists are needed. In urban areas strong fence may be necessary where it is found that pedestrians, particularly children, choose to cross the controlled access highway directly.

Telephones

Regarding telephones on Interstate highways, the AASHO Committee on Planning and Design Policies obtained a legal opinion from the General Counsel of the Bureau of Public Roads as to whether public pay station telephones constitute a private commercial establishment and, if they do, whether they would be permitted on the Interstate right-of-way. The opinion stated that in view of the legislative history of Section 112 of the Federal-Aid Highway Act of 1956, public pay station telephones would not be considered commercial establishments for serving motor vehicle users and they, therefore, could be installed on the Interstate right-of-way. The AASHO committee is now preparing a preliminary discussion on a policy for such installations, which discussion is to include all other means of emergency communications for serving the traveling public, such as radio telephones and the use of police and other forms of patrols.

With regard to public pay stations, the present thinking is to go slowly and explore the possibilities, giving preference to locations at interchanges or at safety rest areas. The need for such conveniences, or possibly necessities, must be weighed against their nuisance value and hazard unless complete and costly turnouts separated from the through traffic roadways with acceleration and deceleration lanes and spaces for parking vehicles, are provided.

Standards

The Interstate standards or minimum guide values and the policies on frontage roads and safety rest areas are already adopted by the AASHO. The other items are being considered by the committee. Changes will be made (they always have) for this is a working, independent committee I assure you. Some will be adopted as policies by the AASHO and probably accepted by the Bureau of Public Roads for use on highway improvements in which Federal-Aid Interstate funds participate in the cost. Thus, a gradually expanding set of guide values is and will be available representing the best thinking and experience on a nationwide basis; also they will aid materially in assuring reasonable uniformity between States.

It would be a mistake, however, to consider them as anything but guide

(Continued on page 33)

Scramble, Scramble, Who's Got Scramble?

By Charles E. Haley
(Assoc. Mem., ITE)
City Traffic Engineer
Phoenix, Arizona

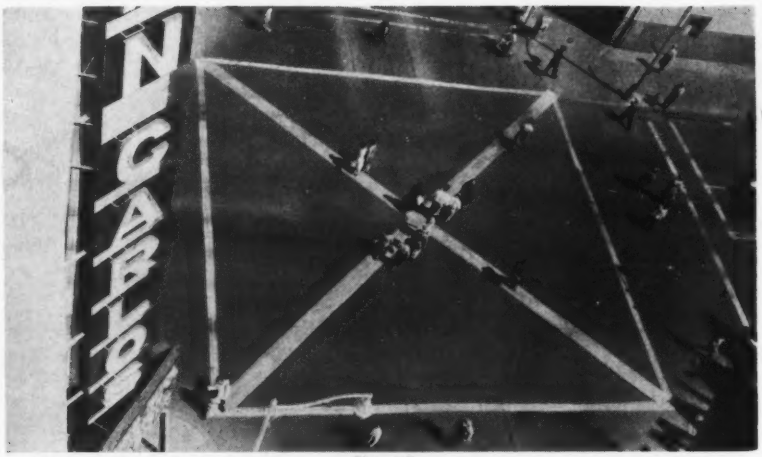

Figure 1
Scramble at one of three "scrambled" intersections in Phoenix. The marking was used to identify these special intersections, and was of temporary paint.

Figure 2
Another of the "scrambled" intersections in Phoenix, which were tried for seven months at the insistence of downtown merchants. At the end of the period, the merchants recommended abolition of the scramble.

POPULATION GROUP No.	NOW USING SCRAMBLE	TRIED AND DISCONTINUED	NOT USED
1	1	1	3
2	3	2	1
3	4	2	2
4	5	0	3
5	8	3	7
6	18	3	24
7	25	4	34
TOTAL	64	15	74
PERCENTAGE	42%	10%	48%

Total answers received: 152. Table totals 153 because Montgomery, Alabama is included in the "Now Using Scramble" and in the "Tried and Discontinued" columns.

THE "SCRAMBLE SYSTEM" (exclusive pedestrian phase) has become the topic of conversation in the downtown areas of our cities whenever traffic is discussed. Scramble has become modern and fashionable, and curbstone traffic engineers in city after city have urged the installation of Scramble as the solution of the "Downtown Traffic Problem." Each city traffic engineer in turn (and if you haven't, you will) has had to recommend for or against Scramble.

In every city where the traffic engineer has recommended against Scramble as the solution for his city's particular problems, he is confronted with the cry, "It works well in Podunk, so why won't it work here?" In city after city each traffic engineer has been placed on the defensive because he is not familiar with Podunk, knows nothing of Podunk's particular problem, does not know their street widths, traffic and pedestrian volumes, signal equipment or timing or even if Podunk has Scramble.

This survey is an attempt to find out what cities are using Scramble, which used it and discontinued it, and which cities are not using Scramble.

Other information requested was: (1) How many intersections are "scrambled," (2) Do pedestrians cross diagonally, (3) What are your "scrambled" street widths, (4) Were you pressured into scramble, and (5) What do you think of Scramble? The section on "What do you think of Scramble" proved extremely interesting, particularly because most persons answering the survey took advantage of the three blank lines provided for "remarks," a most unusual situation. These remarks ranged from a complete satisfaction with Scramble to a bitter denunciation of it. One gentleman in one city stated "Scramble, never heard of it." In the printed summation of the

returns we could not help but add after this comment, "You will!"

Two hundred twelve (212) questionnaires were sent and 152 answers received. This is an excellent 72 per cent return, showing the definite interest in the Scramble System. Following is a table showing that of the 152 cities answering, 42 per cent of them are using the Scramble System, 10 per cent have tried it and discontinued it and 48 per cent are not using it. There are a total of 452 intersections "scrambled" in the 64 cities now using Scramble. Twenty-six cities or 40 per cent of those using Scramble did report the city was "pressured" into using the system against the advice of those in control of traffic.

It would take too much space to print the remarks of each city concerning Scramble. Condensed, these remarks filled 7½ legal size sheets. If you wish, you may have a copy of this survey by writing the author.

Clarence W. Hanson

Clarence W. Hanson (Assoc. Mem., ITE), partner, Modjeski and Masters, Harrisburg, Pennsylvania, died March 26.

Mr. Hanson, whose specialties were the administration of traffic surveys, heavy construction projects, investigations, inspections, reports, and supervision of field projects, had been associated with Ralph Modjeski and partners since 1923, when he graduated from Iowa State College. He served as resident engineer in charge of construction of the Hudson River Bridge at Poughkeepsie, the Maysville Ohio River Bridge, and the New Orleans Mississippi River Bridge from 1928 to 1934. Later he served as executive engineer with the firm, and in 1947 became a partner. In 1943-44 he served in the Army with the Corps of Engineers on overseas assignments.

In addition to his Institute membership, Mr. Hanson was affiliated with the American Society of Civil Engineers, the Pennsylvania Society of Professional Engineers, and the Engineers Society of Pennsylvania.

Figure 3
Overhead signs were used in Phoenix to mark the intersections at which the scramble program was to be tried. The "count-down" started ten days before the program went into effect, with the large "X" painted on the pavement the weekend before the beginning of the operation. The streets shown are a 52-ft. one-way street and a 68-ft. two-way street.

CITIES THAT HAVE TRIED SCRAMBLE AND DISCONTINUED IT

	No. of Intersections	Most Common Street Widths Where Used	Peds. Cross Diagonally
1. Philadelphia	7	61 major, 27 minor	Yes
2. Houston	1	60 major, 52 minor	Yes
3. San Francisco	4	39′	Yes
4. Cincinnati	20	40′	No
5. Milwaukee	3	50′	Yes
6. Jacksonville, Fla.	1	48′	No
7. Rochester, N. Y.	1	50′	No Answer
8. St. Paul, Minn.	2	40′	No
9. Montgomery, Ala.	10*	30′	Yes
10. Peoria, Ill.	1	60′	Yes
11. Phoenix, Ariz.	3	52′	Yes
12. Burbank, Calif.	No Answer	No Answer	No Answer
13. Evanston, Ill.	5	40′ to 70′	No
14. Oak Park, Ill.	1	56′	No Answer
15. Pomona, Calif.	4	46′	Yes

*Montgomery, Ala.—Tried at 12 intersections; discontinued 10; still using at 2.

CITIES THAT ARE USING SCRAMBLE

	No. of Intersections	Most Common Street Widths Where Used	Peds. Cross Diagonally
Group 1 (1,000,000 Pop. & Over)			
1. Los Angeles	21	56′	Yes
Group 2 (750,000 to 1,000,000 Pop.)			
2. Baltimore	45	40′ to 80′	Yes
3. St. Louis	18	No Answer	Yes
4. Washington	10	50′	Yes
Group 3 (500,000 to 750,000 Pop.)			
5. Dallas	1	50′ to 56′ * and 36′	Yes
6. Denver	52	48′	Yes
7. San Antonio	1	30′	No
8. Seattle	8	40′ to 60′	Yes
Group 4 (350,000 to 500,000 Pop.)			
9. Atlanta	3	40′	No
10. Indianapolis	2	30′ to 54′	No

*Offset intersection.

CITIES THAT ARE USING SCRAMBLE (Continued)

	No. of Intersections	Most Common Street Widths Where Used	Peds. Cross Diagonally
11. Kansas City, Mo.	4	30′ to 45′	Yes
12. Louisville	4	36′	Yes
13. Oakland	2	70′ and 80′	Yes
Group 5 (200,000 to 350,000 Pop.)			
14. Dayton	4	30′ to 50′	No
15. Long Beach	10	50′	Yes
16. Miami	3	46′	Yes
17. Oklahoma City	2	68′	Yes
18. Providence	12	30′ to 70′	Yes
19. Richmond	14	80′ and 40′	Yes
20. Salt Lake City	1	No Answer	Yes
21. Toledo	1	36′	Yes
Group 6 (100,000 to 200,000 Pop.)			
22. Albuquerque, N.M.	9	54′ and 40′	Yes
23. Allentown, Pa.	6	50′	Yes
24. Baton Rouge, La.	5	33′	Yes
25. Berkeley, Calif.	1	36′	Yes
26. Chattanooga, Tenn.	4	72′	Yes
27. Erie, Pa.	1	80′	Yes
28. Evansville, Ind.	20	40′ to 50′	Yes
29. Hammond, Ind.	6	52′	Yes
30. Little Rock, Ark.	12	50′	Yes
31. Madison, Wisc.	8	40′ to 62′	Yes
32. Montgomery, Ala.	2*	30′	Yes
33. Nashville, Tenn.	5	32′	Yes
34. New Haven, Conn.	8	36′	Yes
35. Rockford, Ill.	3	50′	Yes
36. Sacramento, Calif.	11	52′	Yes
37. San Jose, Calif.	4	40′ to 68′	Yes
38. St. Petersburg, Fla.	1	60′ and 70′	Yes
39. Wilmington, Del.	2	40′ and 50′	Yes
Group 7 (50,000 to 100,000 Pop.)			
40. Alexandria, Va.	6	36′ to 60′	Yes
41. Asheville, N.C.	2	30′ to 36′	Yes
42. Bethlehem, Pa.	4	60′	Yes
43. Dubuque, Iowa	2	50′	Yes
44. Durham, N.C.	1	36′	Yes
45. Ft. Lauderdale, Fla.	6	50′	Yes
46. Hamilton, Ohio	3	40′	Yes and No**
47. Jackson, Miss.	4	68′	Yes
48. Lancaster, Pa.	1	40′	No
49. Lakewood, Ohio	2	49′	Yes
50. New Rochelle, N.Y.	7	35′	No
51. Orlando, Fla.	5	42′	Yes
52. Pawtucket, R.I.	1	40′—3 legs 65′—4th leg	Yes
53. Portland, Me.	26	50′	Yes
54. Portsmouth, Va.	4	100′	Yes
55. Pueblo, Colo.	6	50′	Yes
56. Racine, Wisc.	5	56′	Yes
57. St. Joseph, Mo.	5	36′	Yes
58. Santa Monica, Calif.	1	58′	Yes
59. Springfield, Mo.	6	46′	Yes
60. Stockton, Calif.	4	44′	Yes
61. Tucson, Ariz.	11	40′ to 50′	Yes
62. W. Palm Beach, Fla.	8	32′ to 40′	Yes
63. Wheeling, W. Va.	4	38′	Yes
64. Woonsocket, R.I.	2	45′ to 65′	Yes

*Tried at 12 intersections; Discontinued 10; Now using at 2.
**Allows pedestrians to cross diagonally at one intersection but not at the other two.

CITIES THAT ARE NOT USING SCRAMBLE AND HAVE NOT TRIED SCRAMBLE, OCTOBER, 1957

Group 1 (1,000,000 Pop. & Over)
1. Chicago
2. Detroit
3. New York City

Group 2 (750,000 to 1,000,000 Pop.)
4. Cleveland

Group 3 (500,000 to 750,000 Pop.)
5. Minneapolis
6. Pittsburgh

Group 4 (350,000 to 500,000 Pop.)
7. Memphis
8. Portland, Ore.
9. San Diego

Group 5 (200,000 to 350,000 Pop.)
10. Akron
11. Birmingham
12. Ft. Worth
13. Norfolk
14. Omaha
15. Tampa
16. Tulsa

Group 6 (100,000 to 200,000 Pop.)
17. Amarillo, Tex.
18. Austin, Tex.
19. Charlotte, N.C.
20. Corpus Christi, Tex.
21. Des Moines, Iowa
22. Duluth, Minn.
23. Elizabeth, N.J.
24. Flint, Mich.
25. Fresno, Calif.
26. Glendale, Calif.
27. Greensboro, N.C.
28. Lansing, Mich.
29. Lincoln, Neb.
30. Lubbock, Tex.
31. Pasadena, Calif.
32. Savannah, Ga.
33. Shreveport, La.
34. South Bend, Ind.
35. Tacoma, Wash.
36. Trenton, N.J.
37. Utica, N.Y.
38. Waco, Tex.
39. Winston-Salem, N.C.
40. Youngstown, Ohio

Group 7 (50,000 to 100,000 Pop.)
41. Alameda, Calif.
42. Battle Creek, Mich.
43. Brockton, Mass.
44. Charleston, S.C.
45. Colorado Springs, Colo.
46. Davenport, Iowa
47. Gadsden, Ala.
48. Greenville, S.C.
49. Jackson, Mich.
50. Kenosha, Wisc.
51. Lexington, Ky.

(Continued on page 44)

Interchange Spacing and Lane Distribution

By T. J. Morawski
(Assoc. Mem., ITE)
Programming and Planning Engineer
U. S. Bureau of Public Roads
Washington, D. C.

WHAT IS A DESIRABLE minimum spacing between interchanges on a fully controlled-access highway? This question has plagued the highway designer, one can safely assume, from the time he laid the line of the first full controlled-access urban highway across the network of existing highways on his drawing board.

The question can be answered from an economic standpoint, using the roaduser benefit-cost ratio method of analysis. But there remains another important consideration — that of traffic operations. In highly urbanized areas, which have many high-volume highways and streets, the basic question resolves itself to this—should an interchange be provided wherever traffic volumes dictate? Is it not possible that a profusion of exit and entrance ramps will disrupt the free-flowing characteristics of through traffic? If so, we have, of course, dissipated the primary advantage of a controlled-access facility.

The problem has become more acute and widespread since the enactment of the 1956 Federal-Aid Highway Act, which provides for the construction of the 41,000-mile National System of Interstate and Defense Highways. One of the major functions of the Interstate System is to connect the important population centers and since Interstate Standards call for the acquisition of controlled access rights-of-way, the impact on our problem is obvious.

In a guide for the preparation and submission of a detailed estimate of the cost of completing the Interstate System, the Bureau of Public Roads stated as follows:—"In or near small cities interchanges will be needed only at the trunk routes that enter or pass through the urban area. In intermediate to large urban areas, interchange should be assumed only at the principal or arterial streets in the local pattern. In and near downtown areas the physical limits of freeway ramp termi-

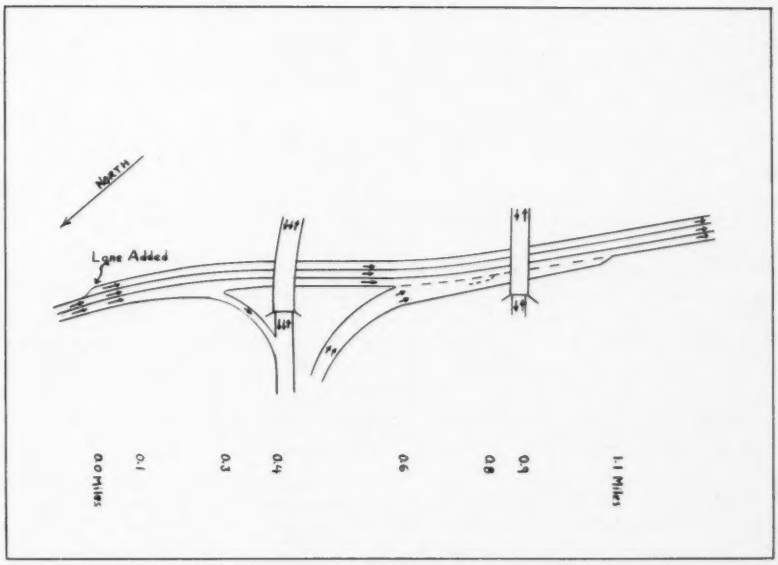

Figure 1
Harriman Interchange New York Thruway.

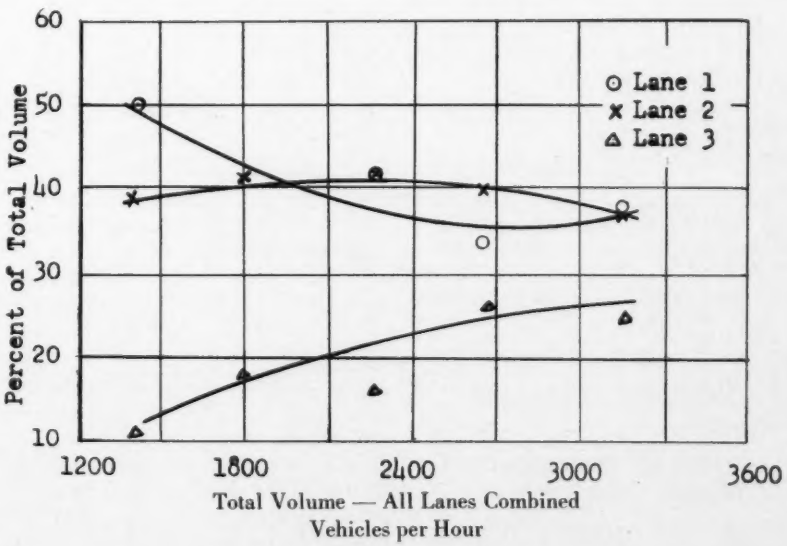

Figure 2
Distribution of vehicles by lanes at end of acceleration lane of entrance ramp.

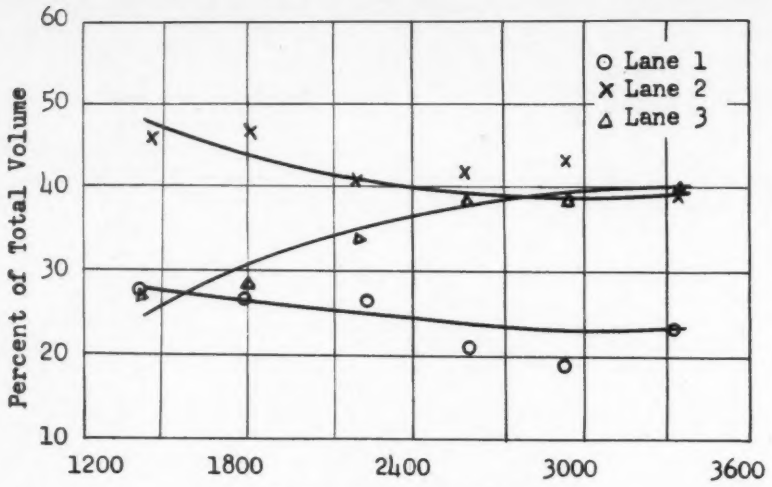

Figure 3
Distribution of vehicles by lanes 1.0 miles south of entrance ramp.

nals usually govern the number of points at which connections can be provided. In the intermediate areas, interchange spacings of 1 to 2 miles appear to be the evolving pattern, increasing to about 2 to 4 miles in suburban outlying areas."

In his article "Some Aspects of Freeway Design and Operation," TRAFFIC ENGINEERING, April 1957, Terry J. Owens, Urban Highway Engineer of the Automotive Safety Foundation, Washington, D.C., presents this rule of thumb — "One mile between interchanges is a desirable minimum with one-half mile an absolute minimum."

In a study of traffic stream flow characteristics in the vicinity of the interchange on the New York Thruway at Harriman, data were obtained on lane distribution which will be analyzed here from the standpoint of interchange spacing and lane distribution. Although the field data were obtained for another purpose* their analysis is significant.

Figure 1 is a sketch of the Harriman Interchange. The peculiar characteristics to be noted are that a lane has been added to the median side of the Thruway just before the interchange area and that the entrance ramp has an acceleration distance of 0.5 miles, being two lanes in width for approximately half that distance.

*"Stream Flow Characteristics of a Three Lane One-Way Roadway Near Transition From Two to Three Lanes." Student Thesis, Yale Bureau of Highway Traffic, 1957.

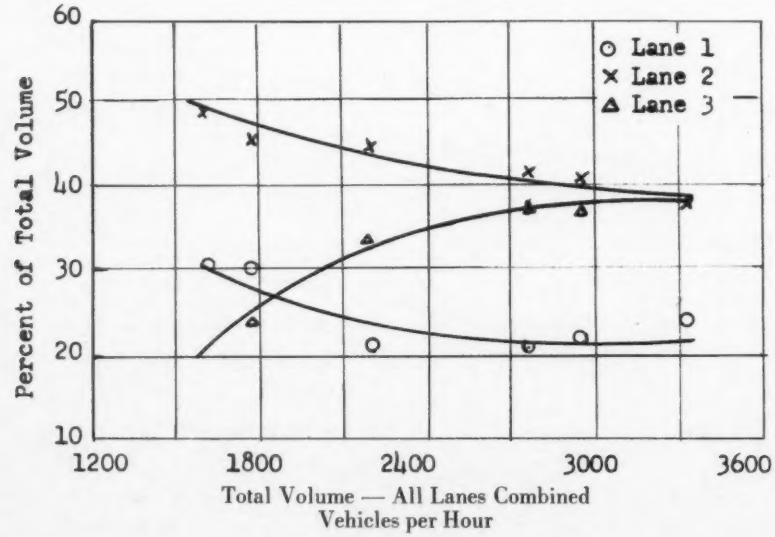

Figure 4
Distribution of vehicles by lanes 2.0 miles south of entrance ramp.

The data below are presented on the basis of equivalent hourly volumes. Actual counts were taken, however, for periods of only five minutes each. These five-minute counts were considered to be representative of hourly volumes and were expanded to quivalent hourly volumes by multiplying by twelve. This technique has been employed in previous studies by others and results have been found to be reasonable. A lower factor would apply to approximate full hour volumes during peak periods.

Lane numbers used below are defined as follows:

Lane 1—The lane on the outside, adjacent to the shoulder.
Lane 2—The center lane.
Lane 3—The lane on the inside, adjacent to the median strip.

Figures 2 through 5 show the percentage distribution of vehicles by lanes at the end of the acceleration of the entrance ramp and 1.0 mile, 2.0 miles, and 3.0 miles south of this location, respectively. At the entrance ramp, in the low volume range, the greatest number of vehicles occurred in Lane 1 and the least number in Lane 3. As volumes increased, the percentage in Lane 2 increased and decreased in Lane 1 until they became equal to a total volume of about 1900 v.p.h. Beyond this volume, the distribution within the two lanes remained within 5 per cent of each other, with about 38 per cent in each lane, but decreasing slightly. The percentage in Lane 3 increased at a relatively uniform rate throughout the whole range.

At the points 1.0, 2.0, and 3.0 miles south, in the low volume range, Lane 2 had the most vehicles with Lane 3 still having the least, Lane 3 became equal to Lane 1 at total volumes of 1550 v.p.h., at 1.0 mile south, and at about 1800 v.p.h., 2.0 and 3.0 miles south. Percentagewise, Lane 3 continued to increase and Lane 2 decrease, becoming equal at about 2800 v.p.h., 1.0 mile south, nearly equal at about 3000 v.p.h., 2.0 miles south, and equal at about 2600 v.p.h., 3.0 miles south. Beyond these volumes Lanes 2 and 3 remained nearly equal, averaging about 39 per cent in each case.

Figure 6 shows the percentage distribution of vehicles by lanes at a location 10.1 miles south of the entrance ramp. The observed equivalent hourly volumes ranged only from 1960 to

2330 vehicles so only an indication of distribution was obtained.

The similarity of lane distribution at the points 1.0, 2.0, and 3.0 miles south of the entrance ramp, and the dissimilarity between the distribution at these points and at the entrance ramp itself leads to the conclusion that lane distribution becomes normal within one mile after the introduction of an entrance ramp.

A comparison was also made with the results reported by M. W. Lotspeich, Jr., in his student thesis "Multilane Flow Characteristics," Yale Bureau of Highway Traffic, 1955. Each of the lane distributions south of the entrance ramp are quite similar to the distribution found by Lotspeich on the New Jersey Turnpike at a location considered to be outside the influence of any ramps and therefore "normal."

In each instance the volume in Lane 3 became equal to the volume in Lane 1 at a total volume of about 1800 v.p.h. and at about 27 per cent. There is a variation in that Lotspeich found Lane 3 became equal to Lane 2 at about 3500 v.p.h. and 38 per cent while the values for the three locations in this study ranged from 2600 to 3500 v.p.h. and at about 39 per cent. This variation is not considered to be significant.

Knowing that lane distribution becomes normal within a mile allows us to conclude that the vehicle operators are in the lane of their choice by that time and only a normal amount of lane changing will take place until another ramp is introduced. By introducing the next interchange after the traffic becomes normal will preclude the compounding of the lane movements into weaving movements, with their resultant conflicts and adverse effect on capacity and free flow.

The importance of a normal distribution is also emphasized by the fact that only as many vehicles can enter from the ramp as there are acceptable gaps in the traffic stream in Lane 1. A normal distribution has a low percentage of vehicles in Lane 1.

It is realized that the results discussed above are based on data obtained at only one rural location and that this location has the individual characteristics of a lane added just prior to the interchange and an entrance ramp with a long acceleration distance. However, the results indicate that under these conditions, a "normal" lane distribution was reached at a distance of one mile, which sugegsts a minimum spacing between interchanges. To this minimum spacing should be added the distance necessary for traffic to readjust itself to the lane distribution required for proper operations at the next interchange.

Under some conditions normal lane distribution might be reached prior to a point a mile from the entrance ramp, but such information was not obtained in this study. The same type of study at other locations, with additional observation points closer to the entrance ramp, and with observance of lane changes, would provide more conclusive data.

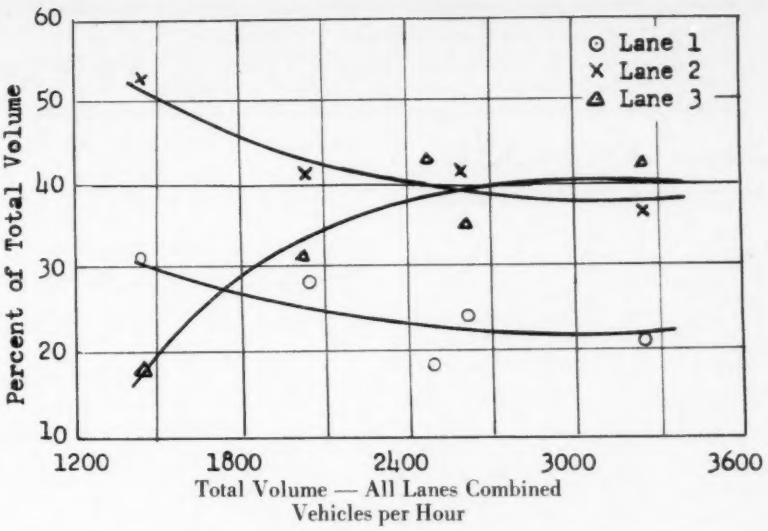

Figure 5
Distribution of vehicles by lanes 3.0 miles south of entrance ramp.

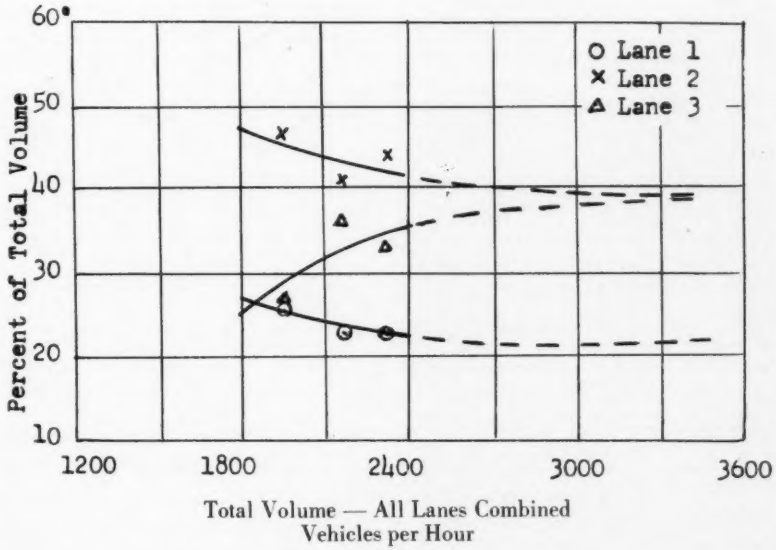

Figure 6
Distribution of vehicles by lanes 10.0 miles south of entrance ramp.

Come One, Come All!

INSTITUTE OF TRAFFIC ENGINEERS

1958
ANNUAL MEETING

Deauville Hotel
Miami Beach, Florida

November 11-13, 1958

Traffic News

Digest of Federal-Aid Highway Act of 1958

The Federal-Aid Highway Act of 1958 authorizing funds for construction on the Interstate System, the regular Federal-aid highway systems and public domain roads totaling $3.260 billion was approved by the President on April 16, 1958 and becomes Public Law 85-381.

New Federal funds made available by the Act are $800 million for the Interstate System; $2.225 billion for the primary and secondary systems and urban extensions and $235 million for public domain roads. State monies required to match the Federal funds, under varying ratios, total $2,113 billion for a grand total Federal and state of $5.373 billion.

Interstate System Funds — Sec. 108 (b) of the Federal-Aid Highway Act of 1956 is amended to authorize an additional $800 million for the next three fiscal years ending June 30, 1959, 1960 and 1961 as shown on Table I.

TABLE I

Fiscal Year	Present Authorization	Supplemental Authorization	New Authorization
1959	$2,000,000,000	$200,000,000	$2,200,000,000
1960	2,200,000,000	300,000,000	2,500,000,000
1961	2,200,000,000	300,000,000	2,500,000,000
		$800,000,000	

The supplemental 1959 authorization is required to be apportioned immediately. (The funds are made available to the states on a 90 Federal/10 state basis, except in public lands states where the Federal contribution may go as high as 95 per cent.)

Approval of Increased Needs Estimate — The increased estimate of cost of completing the Interstate System, published as House Document 300 — 85th Congress, Second Session, is approved as the basis for making Interstate System apportionments only for the fiscal year 1960.

Suspension of Byrd Amendment — Sec. 209 (g) of the 1956 Act, (the so-called Byrd Amendment) which limits apportionment of Interstate System funds in any year to the estimated available amounts in the Highway Trust Fund, is suspended for the fiscal years 1959 and 1960. The Secretary of Commerce is directed to apportion all of the funds authorized for these two fiscal years. (This will require borrowing from the general fund of the Treasury, apparently as repayable advances.)

Supplemental 1959 Primary and Secondary Funds — An additional amount of $400 million is authorized for fiscal year 1959 for the regular Federal-aid systems. This is to be made immediately available to the states on a 66⅔ Federal — 33⅓ state matching basis, subject to a 95 per cent maximum in public lands states. These funds may be expended on primary, secondary or urban projects without limitation to amounts expended on any one system. (Other regular Federal-aid funds are limited to 20 per cent transfer between systems.)

These funds must be expended pursuant to contracts awarded or work commenced prior to December 1, 1958 for completion of construction prior to December 1, 1959. The only exceptions are delays caused by circumstances and conditions beyond the control of, and not the fault of, any contractor and by delays created by acts of God. Any funds not under contract by December 1, 1958 shall lapse.

To assist the states in meeting the matching requirements, an additional $115 million is authorized on which the states may borrow, up to two-thirds of their 33⅓ per cent share. The Federal Government would be reimbursed for amounts so borrowed by deductions in equal installments, from the states' 1961 and 1962 Federal-aid apportionments.

1960 and 1961 Primary and Secondary System Funds—The Act authorizes funds for the primary and secondary systems and urban extensions as shown on Table II.

TABLE II

System	1960	1961
Primary	$405,000,000	$416,250,000
Secondary	270,000,000	277,500,000
Urban extensions	225,000,000	231,250,000
	$900,000,000	$925,000,000

These funds are made available to the states on the traditional 50 Federal —50 state matching basis.

Public Domain Roads — Funds for public domain roads are authorized as shown on Table III.

TABLE III

	1959 (additional)	1960	1961
Forest Highways	$5,000,000	$33,000,000	$33,000,000
Forest Development Roads & Trails	5,000,000	30,000,000	30,000,000
Park Roads		18,000,000	18,000,000
Parkways		16,000,000	16,000,000
Indian Roads		12,000,000	12,000,000
Public Lands Highways	1,000,000	3,000,000	3,000,000
TOTAL	$11,000,000	$112,000,000	$112,000,000

Any state may use either $500,000 or five per cent of primary, secondary and urban funds, whichever is the lesser, for fiscal years 1960 and 1961 for construction of forest highways on any Federal-aid system.

The Secretary of Commerce in cooperation with the Secretary of Agriculture and the states is required to make a study to determine:

1. The forest roads of primary importance that have not been designated as forest highways.

2. Amounts necessary to complete construction of all designated forest highways.

3. Amounts necessary for fiscal year 1962 and each of the succeeding fiscal years through 1971 to construct and maintain forest highways including proposed additions.

4. The method of apportionment of amounts so determined to be needed.

The report of such study is required to be made to the President and Congress on or before January 1, 1960.

Payments for Stockpiled Materials—Sec. 13 of the 1921 Federal Highway Act is amended to authorize the Federal Government to reimburse the states for the value of materials stockpiled in the vicinity of Federal-aid highway construction. (Previously reimbursement could not be made until the materials had become part of the construction.)

Utility Reimbursement—A provision is added to Sec. 111 of the 1956 Act requiring the states to submit evidence, satisfactory to the Secretary of Commerce, that the cost of utility facility relocation has been paid from state funds before Federal reimbursement can be made.

Public Hearings—Sec. 116 (c) of the 1956 Act is amended by adding a requirement that states shall hold hearings, or afford the opportunity of hearings, to enable persons in rural areas to express objections they may have to the proposed location of the Interstate System through or contiguous to their property. (The 1956 Act requires such hearings only when a Federal-aid highway is proposed to bypass or go through any city, town or village.)

Billboard Control — The national policy is declared to be "that the erection and maintenance of outdoor advertising signs, displays, or devices within 660 feet of the edge of the right-of-way and visible from the main-traveled way of all portions of the Interstate System constructed upon any part of right-of-way, the entire width of which is acquired subsequent to July 1, 1956, should be regulated, consistent with national standards to be prepared and promulgated by the Secretary . . ."

The national standards to be promulgated by the Secretary of Commerce would permit only (1) directional or other official signs authorized by law; (2) ads for the sale or lease of property upon which they are located; (3) signs authorized under state law, advertising activities within 12 miles of the location of the signs, and (4) "signs designed to give information in the specific interest of the traveling public."

The Secretary of Commerce is authorized to enter into agreements with the states to carry out the national policy. The agreement may exclude from application of the national standards "segments of the Interstate System which traverse incorporated municipalities, wherein the use of real property adjacent to the Interstate System is subject to municipal regulation or control, or which traverse other areas where the land use is clearly established by State law as industrial or commercial." Segments so excluded are not eligible for the incentive bonus. Agreements may include "provisions for preservation of natural beauty, prevention of erosion, landscaping, reforestation, development of viewpoints for scenic attractions that are accessible to the public without charge, and the erection of markers, signs, or plaques, and development of areas in appreciation of sites of historical significance."

As an incentive for states to enter into such agreements, the Federal share of the cost of an Interstate System project would be increased by half of one per cent if such agreements are entered into by July 1, 1961. Additional funds to pay the half of one per cent would come from Treasury general funds.

In addition, states that acquire the right to advertise or regulate advertising along the Interstate System may include such acquisition costs in the cost of the project and be reimbursed this amount if it does not exceed five per cent of the cost of the right-of-way.

Electronics to Help Maintain London Bus Headways

—Photo courtesy British Information Services

London Transport, which operates London's bus system, is experimenting with an electronic scanning device to help maintain proper headways. The picture shows a driver examining a reflecting device attached to his bus which will transmit a code number to photo-electric cells located at strategic points along the bus route. The signal is relayed by wire to a central control room where the dispatcher can determine the exact situation on the street.

MOTOR VEHICLE DEATHS AND DEATH RATES
1956, 1957 and 1958

	1956	1957	1958	1956-58 Change	1957-58 Change
January	2,954	2,870	2,730	— 8%	— 5%
February	2,652	2,470	2,350	—11%	— 5%
Two months	5,606	5,340	5,080	— 9%	— 5%
March	2,940	2,880			
April	2,970	2,970			
May	3,094	3,000			
June	3,338	3,340			
July	3,555	3,240			
August	3,535	3,680			
September	3,653	3,330			
October	3,476	3,480			
November	3,603	3,530			
December	3,858	3,710			
Total	39,628	38,500			

All 1956 figures are from the National Office of Vital Statistics.
All others are National Safety Council estimates.

Computer Program for Traffic Assignment Being Developed

The Bureau of Public Roads is currently preparing an electronic computer program for traffic assignment to be issued as part of their library program. The method of assigning traffic is based on the material contained in AASHO's "A Policy on Arterial Highways in Urban Areas" and the computer technique relies heavily on the Highway Research Board Bulletin 130, "Traffic Assignment by Mechanical Methods."

The routine is designed to convert map measurements in inches along the best existing route and proposed route into miles and then into minutes of travel time. Up to five different travel speeds can be specified by the designer. The machine will then compute the travel time ratio and select the percentage of diverted traffic from any diversion curve based on a time ratio.

Once the number of trips diverted to the proposed route are determined, the machine records the volumes with respect to where they enter and leave the new route and then totals them to provide an estimate of the ADT volumes on various sections of the highway. In addition, the computation of the vehicle-miles and vehicle-minutes spent by traffic in traveling along the existing route and the alternate proposed routes furnishes data for subsequent cost-benefit ratio comparisons of the various alternates.

The coded machine instructions for the IBM 650, as well as the program write-up, can be obtained from Edwards and Kelcey, 3 William Street, Newark, New Jersey; who originally submitted the program to the Bureau of Public Roads.

Butcher Named to County Engineer Consultant Group by Public Roads

Mason A. Butcher (Mem., ITE), Director of Public Works for Montgomery County, Maryland, has been named one of nine county engineers to serve as consultants to the Bureau of Public Roads, Bertram D. Tallamy, Federal Highway Administrator, has announced. The nine-man Board of County Engineers will provide the Bureau with a highly qualified consultant from each geographic area of the United States.

The Board will be chiefly concerned with plans involving construction and improvement of secondary or farm-to-market roads which are eligible for Federal aid.

"The long experience and high calibre of these consultants undoubtedly will foster greater mutual understanding and better teamwork between the engineers of the counties, the State highway departments and the Bureau of Public Roads," Mr. Tallamy said.

"In the postwar period 1946-54, before the new huge highway program was launched, a similar group of county experts was of great assistance to the Bureau," Mr. Tallamy added, "and we look for even closer cooperation in carrying out the present program."

The other eight who agreed to serve are:

F. Ray Williams, County Superintendent of Highways, County Building, Saratoga Springs, N. Y.

R. L. Morrison, County Engineer, Forrest and Stone Counties, P. O. Box 301, Hattiesburg, Miss.

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Lyle Fuller, County Highway Commissioner, Marathon County, Wausau, Wis.

George W. Deibler, County Engineer, St. Louis County, Duluth, Minn.

Joe Abramson, Parish Engineer, Caddo Parish, Shreveport, La.

Walter A. Burg, Pima County Engineer, 1313 South Mission Road, Tucson, Ariz.

Donald B. West, County Engineer, Chelan County, Wenatchee, Wash.

Lamont B. Gunderson, Chairman of the Board of County Commissioners of Salt Lake County, Salt Lake City, Utah.

New Lighting Equipment To Be Tested on N. J. Turnpike

The New Jersey Turnpike Authority has completed the erection of equipment for its field test of roadway lighting in the Newark-Elizabeth area, it was announced today by Joseph Morecraft, Jr., Chairman of the Authority.

"This test lighting, covering about a half mile, consists of a combination of fluorescent and incandescent lights, and is designated to improve visibility for drivers during periods of adverse weather conditions," said Mr. Morecraft.

Toward the Elizabeth area a section of 500 feet of fluorescent lights, furnished by the Sylvania Lighting Products, a division of Sylvania Electric Products, Inc., as part of experiment, is arranged to cast light horizontally across the three travel lanes on both sides. North of that, for about 2,000 feet the incandescent lights have been erected on poles, to cast light vertically on inside lanes in both directions.

The system is patterned after a principle developed by the Illuminating Engineering Research Institute, in which the light is directed at right angles to the drivers' line of vision. The equipment is so designed that different sizes and types of lights may be tested.

The area in which the lights have been installed is one in which fog and smoke have created hazardous driving conditions and low visibility as to necessitate closing of a stretch of the Turnpike on several occasions.

"The Authority has participated in the financing of scientific research which is being conducted by Pennsylvania State University and Michigan State University to devise lighting which will penetrate fog," said Mr. Morecraft.

"It is contemplated that the Authority will participate in the financing of further research in the hope of arriving at some satisfactory installation. It is hoped, too, that the experimental lighting on the New Jersey Turnpike, which is being closely coordinated with this research, will lead to real advancement in the field of roadway illumination."

Connecticut Continuously Lights 53-Mile Stretch Of Turnpike

The State of Connecticut has installed lighting on a 53-mile stretch of the Connecticut Turnpike.

Commissioner Newman E. Argraves of the Connecticut State Highway Department said the installation, believed to be the nation's longest strip of continuous highway lighting, will extend from Greenwich at the New York State line to Branford.

Modern 21,000-lumen mercury units will carry the brunt of the illumination job while high-output 49,000 lumen mercury luminaries will be installed on wide toll plazas. Fluorescent luminaires will be used for lighting underpasses, and other equipment units will provide illumination of highway guide signs for increased nighttime visibility.

Commissioner Argraves explained the State's decision to light the western portion of the turnpike by pointing out that the 53-mile stretch is dotted by 50 interchanges which must be lighted to provide maximum safety for nighttime motorists. To light these areas and leave the remainder of this part of the highway unlighted, he said, would impose "severe handicaps" on motorists. "It simply is not possible for the eye to continually readjust to darkness, then light, then darkness again at frequent intervals for 53 miles," he commented. "We feel we are doing nothing more than what is required to maintain safe nighttime driving conditions by taking this approach to highway lighting."

Mr. Argraves said that continuous lighting was decided upon as a means of accomplishing three main objectives:

1. To help reduce nighttime accidents and fatalities by providing brightness contrast to permit obstacle recognition.

2. To contribute to driver comfort and thus tend to lessen the early evening peak loads by stimulating greater after-dark use.

3. To increase roadway capacity through traffic placement more nearly in accord with the daytime pattern.

Prior to announcing the decision to install continuous roadway lighting on the western leg of the turnpike, the State of Connecticut conducted a thorough investigation to evaluate — by means of a public opinion survey of highway users and of street lighting experts — the value of lighting on a high-speed expressway such as this 60 mph route. The results show that the public is overwhelmingly in favor of continuous lighting on the highway.

ASF Fellowship Offered At Michigan State

A $2,000 fellowship has been offered by the Automotive Safety Foundation of Washington, D.C. for study in the field of highway traffic administration at Michigan State University. Announcement of the fellowship came today from the School of Police Administration and Public Safety and the Highway Traffic Safety Center at the university.

The fellowship is open to a person interested in earning a master's degree to further his knowledge and competence in the fields of traffic safety organization administration, driver license administration, traffic safety, public information or related areas, the announcement stated. Eligibility for the fellowship requires that the applicant have a bachelor's degree, high scholastic ability, and work or school experience in the field of highway administration. In announcing the fellowship, the Automotive Safety Foundation stated that there is a great current need for advanced study and training to assist those responsible for administering the agencies having responsibilities for the safe and efficient use of our highway system. The foundation has a long record of support in behalf of policing, engineering, and education in the motor vehicle transportation field.

Applications for the fellowship should be sent to The Director, School of Police Administration and Public Safety, Michigan State University, East Lansing, Michigan. Deadline for applications is June 1, 1958. Selection will be made by a committee composed

of members of the staffs of the Highway Traffic Safety Center and the School of Police Administration and Public Safety.

Facilities at Michigan State include one of the most complete libraries of material relating to highway transportation and safety in the United States, numerous courses in traffic engineering, urban planning, safety and driver education, police administration and other areas having an interest in highway transportation.

The letter of application should provide biographical information, background of work experience and a statement of ambitions in the highway traffic field, the announcement stated.

Consultants Rate Increase Proposed by NSPE

A maximum per diem rate of $100 for temporary consultants engaged by the Federal Government has been urged by the National Society of Professional Engineers in recommendations made to Congressional appropriations chairmen.

The National Society points out that the maximum current per diem rate of $75 is insufficient for the economically feasible performance of consulting engineering service due to the existing high overhead expenses.

The Society's recommendations call attention to the National Society's position that "the Federal Government deserves and is entitled to the very best engineering talent obtainable."

The National Society also calls attention to the fact that "the net result of a Federal limitation less than $100 per day could very well be that the most qualified engineering firms would refrain from undertaking engineering projects for the Government, leaving the Government's choice to less qualified consultants."

Flashing Signal Operations Studied in Survey of Major City Practices

A recent questionnaire survey of flashing signal operation during low traffic hours has been reported by Robert D. Dier, traffic engineer of Long Beach, California. Forty-two replies from traffic engineers in cities of over 200,000 population indicated varying practices in regard to flashing of regular traffic signals.

Based on the results of the survey, Dier has suggested a uniform policy for flashing signal operation. In general, signals should be operated on a 24-hour "stop and go" basis except under the following conditions:

1. At poorly located intersections where existing fixed-time signal control delays the progressive movement of vehicular traffic along one or more well coordinated traffic signal systems; and provided traffic and accident conditions permit flashing signal operation.

2. At isolated intersections where unnecessary delay caused by existing fixed-time signal control can be alleviated by flashing operation; and provided traffic and accident conditions permit.

3. At locations where flashing signal operation will reduce traffic hazard caused by unusual roadway, weather or traffic conditions.

4. During low volume traffic hours.

When flashing operation is warranted at a signalized intersection, flashing yellow and flashing red should be used with the flashing yellow indi-

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cation controlling the higher volume street and the flashing red indication controlling the lesser volume intersecting street or streets.

Two-thirds of the cities reported that they did not use or recommend flashing operation on through streets having signal systems with good coordination. Flashing was recommended, however, at poorly spaced intersections that otherwise tended to ruin progressive movement within a coordinated system.

Only seven of the forty-two cities reported using flashing at the intersection of two arterial streets, and only two said they used four-way flashing yellow.

Slightly more than half of the answering cities reported using flashing operation at isolated intersections not part of a coordinated signal system. Eight of those not recommending this technique suggested using actuated signals in such situations.

A number of other points were made by one or more of the respondents, including the following:

1. Unusual conditions, such as ice or snow, may require flashing operation at an intersection where approach grades exceed 4 per cent.

2. Semi-actuated signals are used and recommended at isolated or poorly located signalized intersections by eight cities.

3. Four-way flashing yellow signals are considered substandard and hazardous.

4. When flashing operation is used, red is used on the major street, yellow on the minor street and four-way flashing red is used at major signalized intersections.

5. Flashing operation should be dependent upon: street conditions, accident experience, traffic volumes, robbery experience, delay, signal equipment, etc.

6. Twenty-four hour signal operation is recommended in the central business area.

7. When used, flashing operation is generally used between midnight and 6:00 A.M.

8. Bad experience has resulted from flashing operation in some cities. High accident frequency was found during the early portion of the flashing period, resulting in the elimination of flashing operation.

Coming Events

June 11-14 — NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS —
Annual Meeting, Chase-Park Plaza Hotels, St. Louis, Mo. Contact: NSPE, 2029 K St. N.W., Washington 6, D.C. Hotel Fontainebleau, Miami Beach, Fla.

September 16-20 — FOURTH INTERNATIONAL STUDY WEEK IN TRAFFIC ENGINEERING—
Copenhagen, Denmark. Contact: World Touring and Automobile Organization, 32 Chesham Place, London, SW1, England.

September 28 - October 1 — AMERICAN PUBLIC WORKS ASSOCIATION—
Muehlebach Hotel, Kansas City, Mo. Contact: APWA, 1313 E. 60th St., Chicago, Ill.

October 13 - 15 — AMERICAN TRANSIT ASSOCIATION—
Roosevelt Hotel, New Orleans, La. Contact: ATA, 292 Madison Ave., N.Y.C.

October 13 - 17 — AMERICAN SOCIETY OF CIVIL ENGINEERS—
National Convention, Statler Hotel, New York City. Contact: ASCE, 29 W. 39th St., N.Y.C.

October 20-23 — INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION—
Sheraton Hotel, Philadelphia, Pa. Contact: IMSA, 130 W. 42nd St., N.Y.C.

October 20-24—NATIONAL SAFETY CONGRESS
Conrad Hilton, Congress and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Ave., Chicago 11, Ill.

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October 26-31—INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE —
Hotel Fontainebleau, Miami Beach, Fla. Contact: IACP, 618 Mills Bldg. N.W., Washington 6, D.C.

November 10 - 14 — INSTITUTE OF TRAFFIC ENGINEERS—
28th Annual Meeting, Deauville Hotel, Miami Beach, Florida. Contact: ITE, 2029 K St.,NW, Washington 6, D.C.

November 28-December 5—AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS—
Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif. Contact: AASHO, National Press Bldg., Washington 4, D.C.

November 30 - December 3 — AMERICAN MUNICIPAL ASSOCIATION —
Hotel Statler, Boston, Mass. Contact: AMA, 1625 H Street N.W., Washington 6, D.C.

Training Opportunities

May 21-22—MISSOURI TRAFFIC ENGINEERING CONFERENCE—
The 10th Annual Traffic Engineering Conference will be held at the Student Union Building on the campus of the University of Missouri at Columbia. A large number of speakers and panel members will participate in the two-day conference. For information, write: L. W. Corder, Missouri State Highway Department, Jefferson City, Mo.

July 7-19 — INTRODUCTION TO COMPUTER METHODS FOR HIGHWAY AND TRAFFIC ENGINEERS—
To be held at Yale University, New Haven, Connecticut, under the joint auspices of the Yale Bureau of Highway Traffic and the Institute of Transportation and Traffic Engineering of the University of California. Tuition $150. Registration limited. For information, write: Director, Bureau of Highway Traffic, Strathcona Hall, Yale University, New Haven, Conn.

October 29-30 — COMPUTER APPLICATIONS SYMPOSIUM—
The Fifth Annual Computer Applications Symposium, sponsored by Armour Research Foundation, will be held in Chicago October 29 & 30. For information, write: Armour Research Foundation of Illinois Institute of Technology, 10 West 35th Street, Chicago 16, Illinois.

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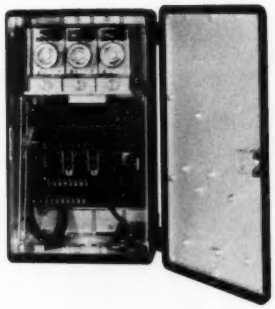
CONTROLLERS  AS FORMERLY SUPPLIED

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New Appointments

Hanson Appointed St. Louis County Traffic Commissioner

Daniel J. Hanson (Assoc. Mem., ITE), formerly Peoria's city traffic engineer, has been appointed Traffic Commissioner of St. Louis County, Missouri.

Hanson, a native of Chicago, became Peoria's first traffic engineer in 1954. Working with City Manager George Bean (now in San Diego), Hanson was responsible for major improvements in traffic operations in Illinois' second largest city.

Earlier Hanson had worked for the Chicago Motor Club and for Champaign, Illinois. A graduate of the University of Illinois, he received his M.S. in Civil Engineering from that institution in 1952.

Hanson has been very active in affairs of both the Midwest Section and the national body of the Institute. He has served for several years as chairman of Committee 4-E, turning the committee over to a new chairman in 1958.

DeNoble Moves from Springfield, Missouri To Little Rock

Henry M. DeNoble (Assoc. Mem., ITE), formerly director of traffic and planning for Springfield, Missouri, has moved to Little Rock, Arkansas, where he will be City Traffic Engineer.

Henry M. DeNoble

In charge of planning and traffic activities in Springfield since February 1955, De Noble had earlier served in various capacities in Lubbock, Texas, including both traffic engineering and planning responsibilities.

Nielsen Goes to Ottawa As Director of TE Services

Thor M. Nielsen (Jun. Mem., ITE) has been named as Director of Traffic Engineering Services for the City of Ottawa, Ontario. In this position he replaces Woodrow W. Rankin, who has returned to the U.S. on the staff at Pittsburgh.

Thor M. Nielsen

Nielsen has been serving as Assistant City Traffic Engineer in Toronto under H. R. Burton. He came to Canada in 1954 from Denmark. Since coming to North America, he has been active in work of the Canadian Section of the Institute.

Colpitts Leaves LA to Become Alhambra Traffic Engineer

Robert J. Colpitts (Jun. Mem., ITE) has been named city traffic engineer of Alhambra, California.

Colpitts had been associated with the Los Angeles Department of Traffic since 1956. Earlier he had worked for the Tacoma (Wash.) Department of Public Works and the Washington State Department of Highways. A graduate of Washington State College, he is also a Junior Member of the American Society of Civil Engineers.

Promotions—Transfers

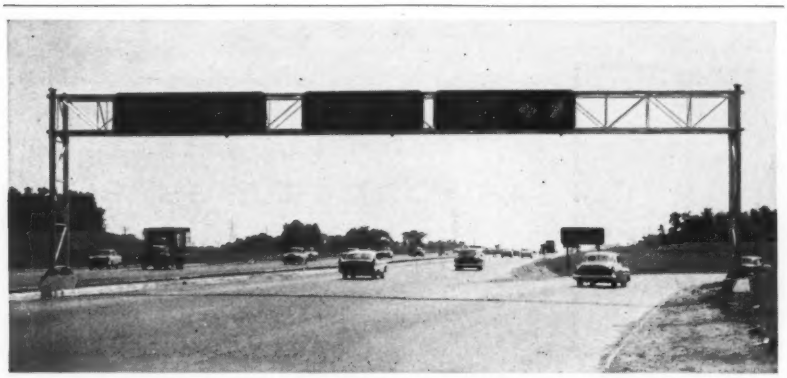
George C. Villegas—to co-manager of the Los Angeles office of DeLeuw, Cather & Co.

* * *

Vealess F. Hudspeth—to Highway Research Engineer, Traffic Operations Section, Colorado Department of Highways.

* * *

John R. Walker—to Comptroller, City Parking Limited, Toronto.



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Manning Named to Traffic Engineering Post In Schenectady

John I. Manning (Jun. Mem., ITE) has been appointed traffic engineer for Schenectady, New York. In this position, Manning will head a bureau in the Engineering Department of the City.

Since October 1956, Manning has been in Syracuse, first as assistant city planner and then as traffic control designer. Earlier he had worked in Philadelphia as assistant traffic planning and survey engineer.

A graduate of Syracuse University in civil engineering, Manning completed the Yale Bureau program in 1955. He is affiliated with the American Society of Civil Engineers in addition to his ITE membership.

James Retires From ASF Staff

The retirement of Stephen James, Director of the Education and Rural Division, Automotive Safety Foundation, has been announced by J. O. Mattson, Foundation president.

Formerly executive director of the Highway Education Board, and Director General of the Pan-American Highway Confederation, Mr. James joined the Foundation staff in 1943. He is widely known in educational and agricultural fields, and also is a member of the Board of Governors and former president of the American Public Relations Association.

Ira B. Rogers, Jr., who joined the Foundation staff in 1954 as Mr. James' assistant, has been named Acting Director of the Division.

New Publications

A Highway Coming My Way?

North Carolina State Highway Commission, Raleigh, N.C. 1958. 12 pp.

This is public relations booklet prepared by the State Highway Commission to explain to citizens the right of way policies and acquisition methods by the State in connection with new highways. It is an interesting approach to a solution of a universal problem, and will be of interest to many state people.

Minimum Standards for Entrances to Highways

North Carolina State Highway Commission, Raleigh, N.C. 1958. 16 pp.

This booklet describes and illustrates the officially adopted standards for entrances to commercial properties across state highway rights of way.

Committee on Traffic Control Devices —Memorandum No. 2

Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C. 1958. 4 pp. (mimeo.)

A subcommittee of the Committee on Traffic Control Devices of the Highway Research Board was appointed in 1957 to recommend criteria for those wishing to develop specifications for supports for traffic control devices. A first memorandum was issued in February 1957—this is a revised draft dated February 1958. It is identified as Circular 355 of the Highway Research Correlation Service, for those interested in obtaining a copy.

The Visual Factors in Automobile Driving

Publication 574, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, Washington 25, D.C. 1958. 25 pp. $1.00.

A summary report of a symposium conducted in November, 1957 under the auspices of the Armed Forces — NRC Committee on Vision. Included are short summaries of the several presentations made at the meeting, together with summaries of the comments and discussion.

Resumé of Traffic Behavior Researches Related to Highway Safety

Bureau of Public Roads, Washington 25, D.C. 1958. 36 pp. (mimeo.)

This is a summary of reports of selected research conducted directly or cooperatively with state highway departments by the U.S. Bureau of Public Roads during the past 20 years. It was prepared in connection with the Human Behavior Research Conference held by the President's Committee for Traffic Safety in February at Williamsburg, Va.

Included are one and two-page summaries of 25 studies, many reported in various publications of the Highway Research Board or the Bureau, but some previously unreported. Significant conclusions are reported in each case, but methods and analysis techniques are not covered.

INTERSTATE DESIGN

(Continued from page 17)

values. They should not be used to form a handbook. For best results, each project must receive individual attention and analysis by competent highway engineers. Only thus can we be assured of our ultimate objective, over-all economic expenditure of public funds for highways of the greatest utility and safety and the most pleasing appearance.

Appearance

I included pleasing appearance because success or failure in this highway program will be determined to a great extent by the opinions of highway users, and their judgment will be influenced chiefly by what they see and how they drive on completed freeways. Few drivers will know or care about the thickness of pavement or the tedious hours spent in materials and soils analyses. Few will remember how long it took or how much it cost.

Carelessness in design of the visible dimensions of a highway, on the other hand, will be evident every day of every year to every driver and passenger, consciously or subconsciously. Highways with long tangents and fixed width of median will not be as pleasing and not be as safe as those with separate alignment and profile for each one-way roadway. Furthermore, in many locations the fixed cross-section type of highway is more costly except for cost of engineering. Here also, conscious thought in design rather than simplified standard practices will give best results.

A Universal Detector Amplifier Relay

J. T. Hewton, Traffic Engineering Department, Municipality of Metropolitan Toronto. Technical Bulletin, Canadian Section, Institute of Traffic Engineers, Grant Bacchus, Secretary, 179 Tavistock Road, Downsview, Ontario. 1958. 10 pp. (mimeo.)

This memorandum describes a transistor-type amplifier suitable for use in connection with magnetic detectors. The amplifier described is reported as avoiding some of the common faults of vacuum tube amplifiers, particularly those of false operation due to extraneous pick-up. While the equipment described is a test-type instrument, it can easily be constructed for permanent application.

Strictly Business

Alcoa Combines Sheets And Extrusions in New Signs

Development of a new line of aluminum highway signs, utilizing both sheet and extruded shapes, has been announced by Aluminum Company of America.

Designed by Alcoa structural engineers, the new signs are said to combine the advantages of aluminum sheet, with its flatter surface for messages, and the ruggedness of extruded shapes, which provide both stiffening action and a fastening system.

The signs are created by welding heavy gauge aluminum sheet to extruded shapes. The technique sacrifices none of the structural characteristics now available in fully extruded signs, while making possible wider panels and a minimum of seams.

The fastening method is the same as designed for Alcoa's Type "A" extruded signs, in which square-head bolts held in a slot in the extrusion are used to connect sign panels to the posts.

Structurally equal to any previous systems, the new signs will withstand winds up to 100 mph. They utilize .080 gauge sheet, and weigh about two pounds per square foot.

For additional information, write 737, Alcoa Building, Pittsburgh, Pa.

L. F. Heckmann Named Union Metal Sales Manager

The Union Metal Manufacturing Company, Canton, Ohio, has announced the appointment of L. F. Heckmann as General Sales Manager. He succeeds D. B. Hanna, former Vice President in Charge of Sales, who retired effective February 28.

A graduate of the University of Illinois, Mr. Heckmann joined the Street Lighting Sales Division of Union Metal in 1937. During World War II he was manager of material priorities. In 1944 he was named Manager of Street Lighting Sales and became Assistant General Sales Manager in 1950. Prior to joining Union Metal he was Manager of Street Lighting Sales for Westinghouse.

L. F. Heckmann

Mr. Heckmann is a member of the Illuminating Engineering Society and Secretary of their Roadway Lighting Committee. He is active in the affairs of the National Electrical Manufacurers Association, presently serving as Chairman of the Technical Committee on Street Lighting.

Program Time Switch For Traffic Signal Control

A program time switch, with 96 tabs on a 24-hour dial to permit 15-minute switching changes is called the ideal control for traffic signals by Tork Time Controls, Inc. It can be used for turning traffic signals ON and OFF, for changing from red light to flashing yellow, or for changing sequences. Called the Tork Model 8001, the new switch offers maximum adjustability in setting up intermittent ON-OFF operation of signals, with the greatest ease of setting with the new tabs.

The 96 tabs are manually tilted in or out; tilting is easily done by hand and no tools are required to adjust settings. To set a daily program, tilt tabs OUT for ON operation; tabs (attached to the dial) left tilted IN denote OFF operation at those times. Tabs may be tilted with gloved hands.

School crossings, factory entrances, and side roads require optimum traffic control at select hours of the day, and full traffic control is seldom required on weekends or holidays. The 8001, offering from 1 to 48 ON-OFF operations per day, in multiples of 15 minutes, will turn traffic signals ON at the exact hours such control is needed. Minimum ON or OFF time is 15 minutes, maximum is 23 hours 45 minutes. It maintains switching conditions when adjacent tabs are set alike.

An optional control, the Tork Skip-A-Day wheel, will keep traffic controls OFF on weekends or holidays . . . on any selected day or days of the week. The Skip-A-Day, built into the 8001, works without altering the master daily cycle as pre-set on the 8001 dial. To alter programs to meet changing conditions, all that's required is to tilt tabs in or out; a set-screw on the daily arm of the seven-armed Skip-A-Day wheel omits operation on that day.

Further information on the Model 8001 is available, without obligation, from the manufacturer, Tork Time Controls, Inc., Mount Vernon, New York.

Heated Pedestrian Ramps Provide Only Dry Footing

Pedestrians in the nation's capital got one pleasant break when an unprecedented February storm dropped 12 inches of snow on the city. Some of the few dry spots in the city were the pedestrian ramps over Kenilworth Avenue, which are equipped with wrought iron snow melting systems.

Grids of wrought iron pipe imbedded in the concrete walking surfaces of eight new ramps across Kennilworth Avenue carry heated ethelyn-glycol to melt snow and ice on the walking surface. In addition, the ramps themselves elevate pedestrians over the busy thorofare.

Approximately 14 tons of ¾ to 2-in. pipe — about three miles — have been used in the piping systems for the eight ramps.

Each ramp is 10 ft. wide and 110 ft. long. Piping is installed in a semi-grid form with reverse returns. The cross

Ramp over Kenilworth Avenue, Washington, D.C., equipped with a snow melting system.

coils are fabricated from 1-in. wrought iron pipe, which has almost the same expansion and contraction co-efficient as concrete. The pipes are installed on 12-in. centers, 9-ft. long, perpendicular to the long axis of the ramp. There are 10 cross coils per ramp with each coil consisting of 10 passes. Because of the slope of the ramp, coils are vented at the top.

The enclosed area under each ramp has been utilized for installation of a gas-fired boiler which, once operating, keeps the heat transfer solution at a temperature of 150 degrees automatically.

Grid systems are connected to the boiler by 1 and 1½-in pipes installed under the walkways. Supply and return of ethelyn-glycol from each cross coil is valved so that any particular coil can be taken out of operation without shutting down the system.

The system was designed by R. A. Close, bridge engineer with the District of Columbia, and installed by the E. J. Febry Company of Washington, D.C.

New Flashers Announced By Pacific Mercury

Pacific Mercury, electronic manufacturers and producers of the Thomas organ, have announced details of their new flasher warning lights, a new product line for the company's Joplin (Missouri) division.

Pacific Mercury flasher lights are available in both neon and transistor models. Both models have the operating mechanism sealed in plastic.

Lights are vapor-proof, impact resistant, and will operate with top efficiency in any extremes of climate, according to the manufacturer.

Maximum visibility, reliability and economy of operation were Pacific Mercury's main objectives in the design and engineering of their flasher lights. Final products meet and even surpass the standards set up for Air Force bomber guidance systems, the company claims, yet operating cost has been kept low. Neon type Pacific Mercury flasher lights will operate up to three months, 24 hours a day, on a low cost standard battery. Transistorized models will operate around the clock for 30 to 60 days on two batteries. Battery reload has been reduced to "twist of the wrist" simplicity; there are no snaps or bolts with which to fumble.

Cast aluminum housing on Pacific Mercury flasher lights is extremely

rugged, all but eliminates damage from collision and insures long, long service life. Lense are quadruple thick and of optical quality so there is little or no need for lens replacement. Threaded steel insert in the housing permits easy attachment—with just a standard bolt—to stand or barricade.

Unique tube design developed by Pacific Mercury gives 7,000 to 12,000-foot visibility extending 4,000 to 5,500 feet, with gradual decrease in intensity after the first week of operation.

Literature on the new lights may be had from Pacific Mercury sales headquarters, 14052 Burbank Boulevard, Van Nuys, California.

'Four-Wheel Drive' Mower Developed for Hills, Slopes

A "four-wheel drive" sickle bar mower, the first specifically designed for use by highway departments and others having mowing problems on steep hills and slopes, has been developed by a Minneapolis firm.

Four driving wheels—two pair of 16-inch wheels on a single axle—are now available on all new Jari Champion and Monarch sickle bar mowers through factory installation of Jari's "Hillside" dual wheel attachments.

Providing twice the traction of standard models, the new "Hillside" attachment makes mowing on steep hills and slopes a one-man job, according to the manufacturer. And it's stated that the four driving wheels, with a wide 20-inch tread, prevent tipping and sliding during hillside cutting.

Even on level ground four driving wheels are practical, according to Jari experts. Greatly improved traction on sandy, wet, and even swampy ground is claimed from the extra wheels on the self-propelled mowers.

Driving wheels have 1¾-inch solid rubber, puncture-proof tires with self-cleaning flat treads, each cross-grooved for maximum traction.

Jari reports that field testing of sickle bar mowers equipped with the new "Hillside" dual wheel attachment proved so successful that one state highway department placed a substantial order for the new machines even before production was fully underway.

Champion and Monarch models, both powered by 2¾ h.p. engines, incorporate Jari's "floating" sickle bar with its swivel action and self-leveling spring, which follows ground contours accurately regardless of the deflections of the wheels on bumpy and hilly ground. Cutter bars are available in two sizes: 44-inch cutting a 42-inch width and 36-inch for 34-inch width.

Other features include: knife clips, easily adjustable by screw, to maintain accurate setting for long cutting efficiency, a rugged protective fender, streamlined to shed weeds, that covers all working parts, a finger-tip clutch control that disengages engine belts for instant stopping and handlebars that adjust for operator's comfort.

For further information write Jari Products, Inc., 2990 Pillsbury Avenue South, Minneapolis 8, Minn.

Institute Affairs

Seminar Program

The second Freeway Operations Seminar will be held in Sacramento, California, June 16, 17 and 18. Local arrangements, including attendance and housing, are in the hands of a committee headed by George M. Webb, traffic engineer of the California Division of Highways. Program planning is in the hands of the Steering Committee headed by Edward G. Wetzel, vice president of the Institute.

The Seminar will be held at a motel near Sacramento, the El Dorado. Attendance will be drawn from the northern part of California, it is anticipated, although Institute members from the states of the Western Section will be welcomed. As they know, the annual meeting of the Western Section will follow immediately after the Seminar —in fact, the Seminar is expected to end at noon on Wednesday and the annual meeting of the Section to begin with a luncheon that same day.

Although the Steering Committee has not set any schedule as yet, it is anticipated that there will be another seminar sometime in the next year in Southern California, and very likely one in the Pacific Northwest. Although these are only possibilities at this stage, mention is made of them now to explain the basis for attempting to restrict attendance at the Sacramento Seminar.

It is hoped that within a month or so an announcement can be made about further seminars in 1958. Interest has been expressed to date by the New England and Metropolitan New York Sections, by the Southern Section, by the Texas Section, and by the Midwest Section.

Annual Meeting in Miami Beach

It is not too early to begin to think about Miami Beach next November. The local committee has started their mailings, and their thinking and planning is well along. The Deauville Hotel is open and doing a big business — they will be wonderful hosts for us next fall. The rates will be within reason — far less, in fact, than what you would expect to pay in Miami Beach in November at a first-rate hotel.

You will soon have hotel reservation forms and full information about the facilities. Program planning is underway by the Committee on Technical Sessions, and you may be assured of a full technical program. Officially the meeting will begin on Tuesday, November 11, and end on Thursday, November 13. We hope many of you will come Monday, however, and attend technical committee meetings. Friday you would have to spend getting home anyway, so the Committee expects that many of you will stay over and go fishing, or sight-seeing, or to Puerto Rico (or Havana, if all is quiet), or touring Florida. Anyway, there will be a lot of interesting things to do and see, so begin to make your plans now.

ITE Insurance

With nearly 400 members participating in the ITE life insurance plan, the end of the first year and the consequent financial review and report by the Trustees should be of interest. While the detailed report will be made to the Board of Direction at the May meeting, the essential facts can be outlined here.

Contributions collected from members were sufficient to pay all costs the first year and provide a dividend to the Trustees of a little over $10,000. One death claim was paid, in the amount of $7,500. The company tells us, however, that to be actuarily sound we should be building a reserve. The Trustees have therefore voted to put the current dividend (or rather $10,000 to be exact) into a reserve fund to use in paying future claims. This assures the continuance of the plan on a sound basis for another year. At the end of next year another look will be taken at contributions, claims and reserves, with the possibility that some adjustments may have to be made. The company points out that the current weakness in the plan is in the absence of Junior members, and the Trustees have appointed a special committee to develop methods for bringing more of the younger members into the plan.

All Junior members would do well to consider joining the plan, which offers term insurance at a very low rate. Any insurance man will tell you that this is the cheapest kind of insurance, and the kind best suited to young people who need protection for growing families. Healthy Juniors will have no trouble joining the plan at any time. Write to Headquarters for full information.

Binders for the Magazine

Response to two notices about the possibility of binders to hold 12 copies of the magazine has been very good. Letters have been received to indicate a potential sale of some fifty binders without any other promotion. This appears to justify our going ahead with this project, and we will soon announce in the magazine the availability of these attractive and relatively inexpensive binders.

Board Meeting

The Board of Direction meets in Toronto on May 23 and 24 as guests of the Canadian Section. Among items on the agenda will be consideration of a number of membership cases, both new applications and transfers, and discussion of the exact method to be followed in making traffic engineering awards this year in connection with the Annual Inventory of Traffic Safety Activities.

Lists Available from Headquarters

The headquarters staff is in the process of revising a list first prepared a year ago which shows names and mailing addresses of all state traffic engineers—one name for each state. Copies are available — write for one if you would like to have it.

Also underway but not available so soon is a similar list of the city traffic engineers — one name for each city. This will require some searching and probably much correspondence. Tentatively, the list will go down to cities of 50,000 population. It would be helpful, if you know of those who are not Institute members but who are serving as city traffic engineers, for you to drop a note to headquarters to pass along the name. In many cases this will make the preparation of the list easier and the final job more complete.

Some members have inquired about the consultants' list formerly available from headquarters. The Board decided at its last meeting to suspend publication of this list pending investigation of what other societies do about such a list. To date word has been received from ASCE and AIP — the former does not publish a list of consultants and the latter does. The matter will be discussed again by the Board, but for the time being, no list is available.

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—Mr. H. J. Hoose, Traffic Engineer, Charlotte, N. C.

"Five years ago we installed a variable-time cycle Trafflex control system that relieved much of our downtown congestion. But we still found such unpredictable volumes during peak periods that the programmed cycle changes couldn't keep pace.

"It took Crouse-Hinds new Time Cycle Control by Traffic Density to eliminate Charlotte's traffic headaches. Now, by using Crouse-Hinds' new Traffic Density Master Controller in conjunction with our Trafflex Control System – *the flow of traffic controls the time cycle . . . automatically and instantaneously.*

"Detectors placed at strategic points transmit traffic volume to the Master Controller, which evaluates the density and immediately makes necessary changes in the time cycle to relieve congestion. This has resulted in less accumulation of traffic at intersections and less traffic build-up prior to peak periods. In short, we have found that Crouse-Hinds' Time Cycle Control by Traffic Density permits our system to operate at *maximum efficiency at all times.*"

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Yearbook Changes

BASARAN, Suat (Junior)
Military Duty, Anafartalar, San Sok, Alemdar Han 19, Ankara, Turkey.

BYROM, Gustav A. (Junior)
Traffic Planning Supervisor, Division of Traffic Engineering, 3343 Pan American Drive, Miami 33, Florida.

DeNOBLE, Henry M. (Associate)
Traffic Engineer, City Hall, Little Rock, Arkansas.

DRAKE, Gerald L. (Junior)
Associate Traffic Engineer, Wilbur Smith & Associates, 580 Market Street, San Francisco, California. SEND MAIL: 1635 Parrott Drive, San Mateo, California.

FIANDER, Leslie O. (Junior)
Assistant District Maintenance Engineer, Ontario Department of Highways, Parliament Buildings, Toronto, Ontario, Canada. SEND MAIL: 34 Ivorwood Crescent, Scarborough, Ontario, Canada.

HAMILTON, R. Dale (Junior)
Highway Designer, Idaho Department of Highways, 603 Main Street, Box 879, Boise, Idaho. SEND MAIL: 6023 Robertson Drive, Boise, Idaho.

HANSON, Daniel J. (Associate)
Traffic Commissioner, St. Louis County, Room 202, 115 North Meramec Avenue, Clayton 5, Missouri.

HUDSPETH, Vealess F. (Junior)
Highway Research Engineer, Colorado Department of Highways, 4201 East Arkansas Avenue, Denver 22, Colorado. SEND MAIL: 4501 East Florida Avenue, Denver 22, Colorado.

IRVIN, Wilfrid F. (Member)
Assistant Manager, Toronto Transit Commission, 1900 Yonge Street, Toronto 7, Ontario, Canada.

KARNIG, Barkev (Associate)
Acting Traffic Signal Engineer, Ontario Department of Highways, Parliament Buildings, Toronto 2, Ontario, Canada. SEND MAIL: 10 Thursfield Crescent, Toronto 17, Ontario, Canada.

MANNING, John I. (Junior)
City Traffic Engineer, Bureau of Traffic, Department of Engineering, Schenectady, New York. SEND MAIL: Sheridan Village Apartments, Schenectady, New York.

McANDREW, Edward G. (Associate)
Chief, Safety & Industrial Health Section, Atomic Energy Commission, Los Alamos, New Mexico. SEND MAIL: Route 1, Box 92, Santa Fe, New Mexico.

MITCHELL, Robert G. (Associate)
Engineer of Traffic & Planning Design, Connecticut State Highway Department, State Office Building, Hartford, Connecticut.

PAYNE, Junius H. (Associate)
525 West Railroad Avenue, Magnolia, Mississippi.

PEARSON, Russell C. (Junior)
Associate Traffic Engineer, City, 817 H Street, Sacramento, California. SEND MAIL: 5641 Bradd Way, Sacramento 22, California.

VILLEGAS, George C. (Associate)
Co-Manager, De Leuw, Cather & Company, 210 West 7th Street, Los Angeles 14, California. SEND MAIL: 220 East Markland Drive, Monterey Park, California.

WALKER, John R. (Associate)
Comptroller, City Parking Limited, 26 Queen Street East, Toronto, Ontario, Canada. EMpire 8-2601. SEND MAIL: 790 Eglinton Avenue West, Apt. 400, Toronto, Ontario, Canada.

YOUNG, William T. (Associate)
Assistant Traffic & Planning Engineer, S.C. State Highway Department, 1100 Senate Street, Columbia 1, South Carolina. SEND MAIL: 4428 Woodside Haven Drive, Columbia, South Carolina.

Membership Applications

The following applications have been received since the list published in the April issue.

APPLICATIONS FOR TRANSFER

BRUCE, John A.
Traffic Engineer, Public Works Department, Room 480, City & County Building, Denver 2, Colorado. March 31, 1958 for ASSOCIATE grade.

CARMODY, Douglas J.
Director of Traffic & Parking, 717 10th Street, Modesto, California. March 10, 1958 for ASSOCIATE grade.

LEWARCH, Emrys E.
Traffic Engineer, Seattle Engineering Department, 105 Public Safety Building, Seattle 4, Washington. March 21, 1958 for MEMBER grade

NEW APPLICATIONS

BAULE, Charles L.
Civil Engineer II, Bureau of Street Traffic, Room 306, 320 North Clark Street, Chicago 10, Illinois. March 21, 1958 for JUNIOR grade.

BURG, John S.
Assistant Traffic Engineer, Public Works Department, Room 480, City & County Building, Denver 2, Colorado. March 28, 1958 for ASSOCIATE grade.

MOHLE, Robert H.
Graduate Student, Transportation Engineering, University of California, 1301 South 46th Street, Richmond 4, California. April 2, 1958 for JUNIOR grade.

NOLAN, Robert J.
Senior Highway Engineer, N. J. State Highway Department, 1035 Parkway Avenue, Trenton, New Jersey. March 14, 1958 for ASSOCIATE grade.

RAYMOND, John R.
Vice President & Managing Director, Municipal Planning Consultants Co. Ltd., 79 Huntley Street, Toronto 5, Ontario, Canada. March 27, 1958 for JUNIOR grade.

RILEY, Richard B.
Municipal Engineer, A. D. Margison & Associates Ltd., 30 Eglinton Avenue East, Toronto 12, Ontario, Canada. March 31, 1958 for JUNIOR grade.

SIEPKOWSKI, Richard
Traffic Engineering Designer, Chicago Park District, 425 East 14th Boulevard, Chicago, Illinois. March 24, 1958 for ASSOCIATE grade.

SIFRER, Albert
Design Engineer, Illinois Department of Highways, 160 North LaSalle Street, Chicago, Illinois. March 19, 1958 for JUNIOR grade.

WARD, Sam B.
City Engineer, City Hall, P.O. Box 1178, Billings, Montana. April 7, 1958 for ASSOCIATE grade.

Section News

CANADIAN SECTION

Ottawa

The Canadian Good Roads Association has five scholarships available this year for graduate engineers and all interested parties are requested to write the Association at 270 MacLaren St., Ottawa 4, Ontario for details. Two of our members have already been awarded C.G.R.A. fellowships in the past (*Bob Campbell* and *Phil Wade*) and have done exceptional work at the University of California.

John Walker has announced his resignation as General Manager of the Toronto Parking Authority. He has stated that his only immediate plans are to spend a month in the Bahamas.

Toronto

Ed Ewens has announced that he has been approached by an Ontario municipality that is interested in hiring either a traffic engineer or a traffic coordinator at a salary of about $6000 per year. One of the immediate projects would be the setting up and operating of a sign shop. Anyone interested can contact Ed at 462 Morrison Rd., Oakville, Ontario.

The Toronto Group held a dinner meeting on Tuesday, March 4th, at which 90 persons were in attendance. The topic for the night was "The Frederick G. Gardiner Expressway — Its Planning, Design, and Construction." The panel was chaired by Mr. G. O. Grant, Metropolitan Roads Commissioner and the panel members were Mr. Fran Madison (DeLeuw-Cather Co. of Canada), Mr. *Harry Burns* (A.D. Margison & Associates), and Mr. *Ray Desjardins* (Metropolitan Toronto Planning Board).

MIDWEST SECTION

MARCH MEETING

It was Student Night at the March meeting of the Midwest Section as 55 members and their guests were present to host the student visitors and hear the guest speaker, Virgil E. Gunlock, President of the Board of the Chicago Transit Authority. ITE Student Chapter members from the University of Illinois and their advisor, Professor *John Baerwald,* concluded their day-long tour of the Windy City by attending the meeting, which was held at the Western Society of Engineers. Professor *Don Berry* and his Northwestern students were also on hand.

A little adventure was introduced during the reports to President *John Zimmerman* by the chairmen of the various committees. Chairman *Ralph Gross* of the Decoration Committee gave a very lively report on his group's activities in conjunction with the Baerwald project. (Ralph reports that his committee's services are available to any member desiring expert help in decorating his new home. Just another extra exclusively offered to Midwest Section members!) Texas *Mike* ("Head'em off at the bifurcation in the road") *Hartigan* then formally introduced the guest speaker, Virgil Gunlock.

Mr. Gunlock stated that the diagnosis and prognosis of mass transit could be summed up in one word: automobiles. People are not wiling to walk anymore, and the auto satisfies their desire for travel comfort and convenience. The inefficient use of transit vehicles due to unbalanced rider demand during rush hours, the necessity of providing 24-hour service, and surface traffic congestion all contribute to increased operating costs. Transit companies are faced with rising costs of labor and equipment and a loss in revenue due to reduced patronage. He felt that no radical change in this condition can be realized without some form of monetary assistance (formerly called a subsidy).

Mr. Gunlock's prognosis for rapid transit included increased automation through electronics, and possible limited use of helicopters and the monorail. The lively discussion period following Mr. Gunlock's interesting and entertaining talk indicated the high interest in his subject by those present.

License Plate Study

America's first comprehensive study of auto license plates is being undertaken by the University of Illinois at request of Charles F. Carpentier, Illinois Secretary of State, whose office is financing the project.

Professor *John E. Baerwald* (Member, ITE) of the U. of I. College of Engineering will head the work. The first phase, a study of the purposes of license plates, is to be completed by July 1. A study of the best ways of serving these purposes will be finished by a year later.

Delbert F. Karmeier, graduate student in engineering at Illinois, will assist in the first phase study.

This will explore what information a license should convey. In addition to identifying the vehicle, it can include year of issuance, codes for counties or other areas, codes for certain services or restrictions, slogans, and other data.

Study on methods of conveying this information will include design, style, colors, use of reflective surfaces, use of numbers alone or of numbers and letters, license materials, annual or other issuance, use of one or two plates, and other factors.

For the past 20 years, Illinois license plates have had more readable numerals and other improved features as the result of one of the nation's pioneering studies in this field, made in 1937 at the University of Illinois by Professor *C. C. Wiley* (Hon. Member, ITE), now retired.

Since that time the number of autos in the state has nearly tripled, new problems have come up, and new research techniques have been developed.

MISSOURI VALLEY SECTION

Missouri Highway Lighting Conference

A two-day Highway Lighting Conference sponsored by the Missouri State Highway Department was held in Jefferson City, Missouri, on March 5 and 6, 1958. This conference was designed to acquaint highway employees with highway lighting design and maintenance problems. To our knowledge this is the first State Highway Department sponsored Highway Lighting Conference.

Lighting Engineers from General Electric, Westinghouse Electric, Line Material, Union Metal Manufacturing Co., Dron Electric, Missouri Power & Light and American Concrete Companies gave instructions on highway lighting design problems and lighting maintenance and displayed highway lighting equipment. There were fifty-five Missouri State Highway Department employees, nineteen company representatives, four Bureau of Public Roads representatives and two Kansas City Traffic Department representatives attending this conference.

The program included topics on Basic Principles, Design, Photometric Data, Lighting Design Computation, Circuits, Highway Lighting Poles and Mountings, Maintenance of Circuits and Circuit Equipment and Preventive Maintenance. The first day, March 5, was for design technique and computations. The second day was devoted to maintenance problems.

Missouri 10th Annual Traffic Engineering Conference

The 10th Annual Traffic Engineering Conference will be held at the Student Union Building, Missouri University Campus, Columbia, Missouri, on May 21 and 22, 1958. This is the oldest traffic engineering conference in continuous operation in the United States. A wide variety of speakers and panel members are scheduled to participate on the two-day program. All ITE members in the Missouri Valley area are cordially invited to attend this conference. The appointment of a new football coach at M.U. has made enthusiasm for better things run high on the campus. Therefore, visitng dignitaries should come prepared for some football conversation, arguments, wagers, etc.

WESTERN SECTION

Oregon Area

Oregon is faced with a "Principle vs Principal" decision as a result of that section of the Interstate Standards which make white centerlines mandatory on the Interstate System. The question unanswered at this writing seems to be whether holding to the yellow principle is better than getting the green principal.

Bill Albright, Economic Analysis Engineer, and *Glen Loertscher* of the IBM Section, are well along towards completing Phase I of the Section 117 Speed-Accident Study which is being conducted in cooperation with the Bureau of Public Roads. During March a conference was held with the local Bureau representatives to discuss the instructions for Phase II and the possibilities of having a representative from the Bureau's office in Washington, D. C. assist in outlining the IBM program. What with the extensive work to be done on Phase II, it is rumored that we may find Mr. *Loertscher* going on an extended fishing trip at any time.

Forty-two Oregon Area members and guests assembled at Randall's Chuck Wagon in Salem on the evening of March 7 for an Area dinner meeting. Distinguished guests included *"Skinny" DeYoung* and *Al Mathews. Harlan Baxter* came up from Eugene and there was a fine turnout from Portland. *Bud George* talked to the group about Oregon's experience with oversized red signal lenses. He advised that on the basis of before and after accident experience, the oversize lenses have not been effective. *Fred Fowler* discused the program for and purpose of the American Municipal Association and the American Association of State Highway Officials Convention scheduled to be held in Portland March 23-25. All in all, this was a good workshop type meeting, and *Val Johnson,* who was in charge of arrangements, deserves considerable credit for his efforts.

Intermountain Area

Jack Bruce, Al Pepper and selected members of their respective staffs have been named to a special committee of the Colorado Highway Safety Council for the purpose of comparing the "Model Traffic Ord-

inance for Colorado Municipalities" with the "National Model Traffic Ordinance." Jack and Al will specifically cover the Section on "Traffic Administration" relating to powers of the Traffic Engineer in Municipalities, and inasmuch as Jack has just recently completed such a revision for the Denver Municipal Code, no doubt every attempt will be made to improve the role of the Urban Traffic Engineer in the State of Colorado by means of anticipated legislation.

Al Pepper reports an incident which happened recently illustrating the statement that Traffic Engineers will go to any length to prove a point, and may even be accused of staging a production to do so. Al was referring to a recent meeting being held in the downtown office of the Greater Denver Metropolitan Safety Council with other groups (who, incidentally were petitioning a traffic signal). He had just made the remark that signals are not always a panacea since the efficiency still depends on the regulation of human behavior. Lo and behold before he finished the last word in the sentence a resounding crash came up from the street below! Everyone rushed to the window to discover that there had been an outright violation of one of Jack Bruce's "scramble installations" involving three vehicles. Those in attendance immediately accused Al of arranging this display in cooperation with Jack Bruce in order to prove his point. (Ed: End result—delegation withdrew the petition).

Al Pepper is pleased to announce that the Western Section will soon have a new member. *Vealess Hudspeth,* formerly the Traffic Design Engineer with the Arkansas State Highway Department, has succumbed to the rarified air of the Mile High City and is now associated with the Colorado Highway Department as a Highway Research Engineer in Al's office. It is very interesting to watch Vealess counter Colorado's sour dough expressions with his soft drawl. His primary assignment will be in the field of Interstate Traffic Control.

San Diego Area

The City of San Diego has been conducting tests of several plastic pavement striping and marking materials. As a result of these tests, it is planned to install most of the crosswalks and limit lines in the C.B.D. in one of the plastic materials.

The City Engineer Department will join, in July, the Public Works and Utilities (Water and Sewage) Departments to form one large department under one director. Traffic Engineering will continue to operate as a division under the City Engineer. The new Director is to be Paul Beermann (former Water Director). Ed Gabrielson has been appointed as the new City Engineer to succeed Captain Alden K. Fogg who is retiring in July. Mr. Gabrielson is presently the City Design Engineer.

The San Diego Area held a luncheon meeting on March 21, at the San Diego Club. The new area officers were elected at this meeting. Taking over in June will be *Ed Hall* as Area Chairman and *Ben Dobbins* as Scribe. Best of luck, Ed and Ben! Other items on the agenda were nominations of representatives to attend the Freeway Seminar in Sacramento which precedes the WITE Section Meeting in June, and a discussion as to whether or not the San Diego Area should affiliate with the San Diego Engineering Council.

The California Division of Highways completed construction on 1.7 miles of 6 lane (ultimate 8 lanes) Freeway on U. S. 80 in San Diego last month. This section of Freeway encompasses a two quadrant cloverleaf interchange at Lake Murray Blvd. The interchange includes the latest type Collector Road Design and overhead illuminated signs with down pointing arrows. The total cost of the project was $1,300,000. Of this amount $50,000 was expended for items generally considered to be a Traffic Engineering function.

Bay Area

Fifty members and guests attended a dinner meeting in San Francisco on March 12. Guests included Professor *Amos Neyhart,* Director of the Institute of Public Safety at Pennsylvania State University; *John L. Springer,* Executive Director of the Western Highway Institute; *Ed Moore,* Executive Vice-President of CSAA; and *Skinny DeYoung.* The program was devoted to a panel presentation of the accident problem on freeways.

Ross Shoaf discussed the San Francisco freeway with particular emphasis on Bayshore between the bridge and Army Street.

Jay Čizek presented information concerning the Eastshore Freeway in Oakland which included a summary of reported causes of accidents.

Jerry O'Shea then presented the overall freeway picture in District IV.

Slade Hulbert (Assistant Research Psychologist, ITTE UCLA) briefly discussed the role of the driver in freeway accidents. He presented a resume of the research investigations being conducted at U.C.L.A. including the development of a "driver simulator" by which driver reactions to various situations can be analyzed.

The featured speaker on the program was Henry Case from Division of Highways Headquarters office in Sacramento. He pointed out that freeways reduce the problem of driving and minimize the effect of poor driving. Current design policy includes such new features as wider medians with median shoulders, full shoulders on structures, better bridge railing design, and better signing. He mentioned that investigations underway by headquarters on the operation of freeways include on and off-ramp design, lateral clearance at structures, relationships between speed and accidents, and cross median accidents. He discussed the latter research in some detail, informing the group also that statewide study is presently under way for all freeways with volumes over 15,000 ADT for different types of medians classified by width and traversability. The study includes 280 miles of freeway broken down into over 500 sections. Full-scale crash tests are also being conducted to find the best, most economical design for median barriers.

The program was prepared and moderated by *Marty Wallen.* Those attending agreed that it was a most enlightening and informative meeting.

Other gurgles from the Bay include the beginning of the area's third county wide O&D study. *Hank Evans* of Wilbur Smith and Associates is conducting the study for Alameda County.

Bob Glenn reports that the one-week Extension Course, "Fundamentals of Traffic Engineering," will be given in the Los Angeles Area this summer. The date is August 25 through 29. The place will be announced later.

San Diego has just published a comprehensive report on its activities as a Pilot City of the National Committee on Urban Transportation. This report is primarily designed to evaluate the concepts and procedures developed in the Manual of the National Committee. San Diego was one of the two cities that undertook the entire scope of the National Committee Program. This was made possible by the participation of the San Diego Transit System. *Ed Hall* reports that the success of the project was largely due to the spirit of cooperation that has prevailed within the City of San Diego and between the five other cities, the county, the California Division of Highways, the U. S. Navy and the San Diego Transit System. ITE'rs *Steve George* and *Keith Gilbert* contributed to the preparation of the report.

Los Angeles Area

100 members and friends of the Institute gathered at the Los Angeles Police Academy for an area dinner meeting on March 25. *Sam Taylor,* Area Chairman, introduced *Ed Telford,* Assistant State Highway Engineer for District VII as the speaker of the evening. Ed gave an interesting presentation on "Freeway Futures for Southern California."

British Columbia

The present complement of ITE members in British Columbia is as follows:

Ken Vaughan-Birch, City of Vancouver.

John Harding, B.C. Department of Highways, Victoria.

Roy Cowley, B.C. Department of Highways, Victoria.

Fred Hole, City of Vancouver.

Doug Sutcliffe when he was with the B.C. Electric Railway Company, operators of the transit systems in the Vancouver Metropolitan Area and Victoria, was a member of the ITE. Although Doug is now with Western Development and Power Ltd., a sister company of the B.C.E.R., he has recently been compiling a special report on "Operation of Transit Vehicles on the Future Freeways in the Metropolitan Area of Vancouver." He is doing this study at the request of and in cooperation with the Technical Committee for Metropolitan Highway Planning. Doug will be presenting a paper based on this study at the Pacific Coast regional meeting of the American Transit Association in San Diego, May 5-7th.

Ken Vaughan-Birch, who is well known by ITE members in the U.S., is quite active in Canada-wide activities at the moment. Besides his own job as Director of Traffic for the City of Vancouver he is Past President, Canadian Section: ITE; a member of the Markings and Editing Sub-Committees of the Joint Committee on Uniform Traffic Control Devices for Canada; and Vice Chairman of the Committee on Traffic and Operations which forms part of the Advisory Committee on Technical Information for the Canadian Goods Roads Association.

In Vancouver a special study is being conducted on turn prohibition signs for the Joint Committee with emphasis on symbol signs. The use of symbols is prompted in part by the bilingual problem in eastern Canada.

Ken has also accepted an assignment to draft a special section on school and pedestrian signs for the Joint Manual. He has received approval of the Signs Sub-Committee for a proposed school sign having individual characteristics. Instead of being classed with other warning signs as in the U.S., it is considered here to merit special treatment as is the case with the railroad crossing sign. The proposed sign has a pentagonal "schoolhouse" shape with white symbolic school children on a blue background.

Other sub-committee representation by B. C. traffic men is as follows:

John Harding—Signals, Markings, Editing.

Roy Cowley—Signs, Islands, Research.

Norm Worsley (Traffic Engineer for Victoria)—Signs.

Fred Hole—Signals, Research.

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Reference Notes

EFFECT OF ADEQUATE STREET LIGHTING IN REDUCING NIGHT TRAFFIC ACCIDENTS

A report of Technical Committee 4D of the Institute of Traffic Engineers, approved as an Information Report by the Technical Council and the Board of Direction and authorized for publication.

A survey was made by the Committee on Street and Highway Lighting to determine the effect of adequate street illumination on the night traffic accident record. Letters and questionnaires were sent to eighty city traffic engineers. Replies were received from thirteen cities which had installed good street lighting and had some data concerning day and night traffic accidents.

Five of the reporting cities had installed street lighting which approximated the American Standards Association recommendations on a sufficient street mileage to produce significant results. The data from these five cities are shown below.

Denver, Colorado

Denver has carried out an extensive program of street lighting improvement in which the 15,000-lumen mercury vapor lamps were used. On a city-wide basis, the experience at the end of 1953 showed an eighteen per cent reduction in night accidents over a four-year period. These data were based on records for individual streets for one year prior to the lighting improvement and one year after.

Detroit, Michigan

The Detroit street lighting system has been steadily improved since the program of traffic safety lighting was begun in 1936. Most of the principal traffic streets now have excellent lighting which generally equals or exceeds the recommendations of the American Standards Association. There are no recent before-and-after data for Detroit but there were significant improvements in the night accident record in the early years of the safety lighting program. The accompanying table gives the Detroit accident record for recent years.

DETROIT TRAFFIC ACCIDENTS

	All Accidents			Fatal Accidents		
	Day	Night	Per Cent at Night	Day	Night	Per Cent at Night
1951	50,108	29,610	37.1%	81	135	62.5%
1952	45,575	27,797	37.9	72	123	63.1
1953	53,050	31,534	37.3	63	143	69.4
1954	51,305	27,057	34.5	82	146	64.0
1955	51,419	28,426	35.6	87	133	60.5

Kansas City, Missouri

During the ten year period of 1946 to 1955 there was a very extensive improvement program of the Kansas City street lighting system. The number of lamp lumens was approximately doubled and the effective lumens (on the street and sidewalk area) is now more than four times the original value. This relighting program was undertaken primarily to reduce the number of night traffic accidents. The following table shows what the results have been.

KANSAS CITY (Mo.) TRAFFIC ACCIDENTS

	Percentage of Total Accidents Occurring at Night			Lighting Progress End of Year
Year	Fatal	Injury	Prop. Dam.	Percentage of Total Street Relighted
1944	62%	43%	35%	0%
1945	57	50	38	0
1946	61	52	40	2
1947	55	44	34	6
1948	40	44	36	12
1949	56	42	38	21
1950	50	40	37	32
1951	35	38	32	47
1952	39	40	33	57
1953	48	37	28	74
1954	37	33	28	86
1955	38	37	27	87

The above data show that the night accident record has steadily improved as the lighting was increased. The following table for night pedestrian fatalities is also important.

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Kansas City (Mo.) Night Pedestrian Fatalities

Year	Day	Night	Total	Per Cent At Night
1945	6	23	29	79%
1946	12	34	46	74
1947	10	16	26	61
1948	16	15	31	48
1949	6	10	16	62
1950	8	8	16	50
1951	11	6	17	35
1952	10	5	15	33
1953	14	9	23	39
1954	9	6	15	40
1955	9	4	13	31

It is evident that night pedestrian safety has been very greatly increased by the additional street lighting. The day record has been fairly constant throughout the period shown but night deaths were down sharply.

Los Angeles, California

Los Angeles reported on nineteen miles of thoroughfares that had received improved lighting. The original lighting on the street averaged between 0.12 and 0.20 foot candles and this was increased to between 1.0 and 1.5 foot candles. The accident record for these 19 miles of thoroughfares for one year before and one year after the lighting improvement was:

LOS ANGELES TRAFFIC ACCIDENTS — Relighted Streets

	Day		Night	
	Before	After	Before	After
Total Accidents	452	542	415	404
Change	Inc. 20%		Dec. 2.6%	
Pedestrian Accidents	87	82	60	34
Change	Dec. 5.7%		Dec. 43.3%	

Trenton, New Jersey

Thirteen miles of thoroughfares in Trenton were relighted between 1947 and 1950. The lighting was somewhat more than doubled and the final intensities were approximately equal to the American Standards Association recommendations. Records were kept for a two year period before the lighting improvement and a four year period afterward. Assuming that the ratio of night-to-day accidents would have remained the same if the lighting had not been improved, then the results show that the night pedestrian accidents on the relighted streets were actually 47 per cent (85 accidents) less than expected and night non-pedestrian accidents were 4 per cent (49 accidents less than expected.

The above data show that the night accident record was appreciably better after the lighting was improved. The reduction in night pedestrian accidents was particularly impressive.

Other Cities

Reports of day-night accident records in connection with street lighting improvements were also received from Glendale, Calif.; Jackson, Miss.; Philadelphia, Pa.; Richmond, Va.; San Diego, Calif.; Tacoma, Wash.; Tucson, Ariz. and Worcester, Mass. These all related to individual street sections, some of which were relatively short. The detailed data in some cases covered all traffic accidents, in some cases they covered only pedestrian accidents and in other cases the records are divided into fatal, injury and property damage accidents. Due to this variation it is not possible to combine these data into one table. In view of the relatively small street sections covered, the individual records cannot be considered conclusive standing alone.

A brief summary of the reports from these eight cities following lighting improvements is:

Two cities reported good reductions in night pedestrian accidents.

Two cities reported good reductions in total night traffic accidents.

Four cities reported no significant changes in the day-night accident ratio.

In such an investigation of the effect of one safety measure on night traffic accidents it must be noted that numerous other factors are also important. Principal factors other than visibility influencing night safety are traffic law enforcement and accident reporting at night, the operation of the traffic signals during night hours, the greater prevalence of intoxicated drivers, and more drivers affected by fatigue. These factors all have some effect on night traffic safety and adequate street illumination alone cannot overcome such things as the lack of enforcement or the lack of complete signal operation at night.

The results of this survey indicate definitely that where adequate lighting has been provided in a sufficient street length to minimize the element of chance, the night traffic accident record has improved. The extent of such improvement would be influenced by the illumination in service at the beginning of the project and consequently would vary in different cities.

The various reports show that the installation of adequate street illumination has decreased total night accidents by from 15 to 25 per cent. Night pedestrian accidents have been reduced by from 35 to 75 per cent.

SCRAMBLE

(Continued from page 20)

52. Lorain, Ohio
53. Lynn, Mass.
54. Macon, Ga.
55. Manchester, N.H.
56. Medford, Mass.
57. Miami Beach, Fla.
58. New Britain, Conn.
59. Pensacola, Fla.
60. Pontiac, Mich.
61. Raleigh, N.C.
62. Richmond, Calif.
63. Saginaw, Mich.
64. San Bernardino, Calif.
65. San Leandro, Calif.
66. San Mateo, Calif.
67. Santa Barbara, Calif.
68. Schenectady, N. Y.
69. Sioux City, Iowa
70. Sioux Falls, S.D.
71. Springfield, Ill.
72. Waterloo, Iowa
73. Wichita Falls, Tex.
74. West Allis, Wisc.

Cranking BY HAND is old fashioned

There was a time when hand-cranks were used for many things . . . to start an automobile . . . to run the washing machine . . . to pump water and to wind the clock. Maybe they were the "good old days" but they are past and the hand-crank is now an antique curiosity.
Today's modern designs call for automatic operation. This is true wherever you look . . . and it applies to parking meters, too.

EXPIRED
COIN
only the modern PARK-O-METER gives you all these advantages
1 Completely automatic, simple, one-hand operation.
2 No exposed working parts to be affected by weather or to tempt vandalism.
3 Adjustability for Split-rate as well as conventional rate settings and for any coin combination and time limit from 6 minutes to 72 hours.
4 Adjustment to change time, coin and rate combinations can be made without shop overhaul.
5 Accepts Pennies, Nickels, Dimes, Quarters or Tokens, any one or more, or all five through a single coin slot.

HEADLIGHT GLARE VS. MEDIAN WIDTH

By L. J. Ross
(Assoc. Mem., ITE)
Planning Engineer
Idaho Department of Highways
Boise, Idaho

The Idaho Department of Highways adopted a 100-foot basic width between center lines of opposing roadways for design of those sections of the Interstate System wherein it was considered impractical to design the facility on independent horizontal alignment. Almost everyone, at some time or another, questioned whether the increase in cost for structures and additional borrow could be justified to provide this wide a median.

In defense, one argument for such a wide median has been to provide sufficient distance between opposing traffic as to completely eliminate headlight glare and the necessity of having to drive at high speeds on low-beam operation. It is considered contradictory to provide the modern automobile with high-beam headlights for high-speed nighttime driving, and then make it necessary by virtue of roadway design to have the road user drive on low-beam operation with resulting restriction to his nighttime vision. While this argument provided good reasoning for the median width, there has never been, to our knowledge, any conclusive studies as to exactly what width is required to insure safety of operation on four-lane divided highways as related to headlight glare.

During the summer of 1957, one of our district offices became sufficiently interested to conduct actual tests of simulated conditions to prove to themselves the relation between headlight glare and median width. The results of their investigation have been compiled in a report entitled "Headlight Glare Vs. Median Width" wherein they have proven to their own satisfaction that for a design speed of 70 m.p.h, a median width of between 60 feet and 80 feet is necessary in order to reduce headlight glare to the point where it will cause no interference to opposing traffic. This figure corresponds favorably to the 76 foot median which is provided by the 100 foot basic width between center lines.

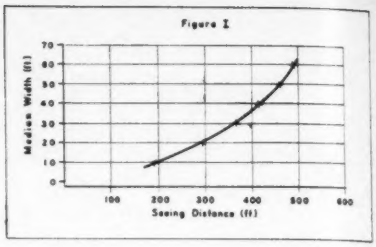
Tests were conducted on a seldom-used graveled airport runway. Small weeds and grass had been allowed to grow and was considered to be more or less representative of anticipated median texture. A base line was stationed at 50 foot intervals for 600 feet. From the base line six 10 foot lanes were defined.

Two methods were employed to determine the relationship of glare to median width. In the first test, a driver would drive down each lane at an average speed of 45 m.p.h. toward a stationary vehicle parked on the base line at station 0 + 00. Both automobiles had their headlights on high beam. An obstacle was placed in the lane down which the moving auto would travel. This obstacle was opposite the stationary automobile, but far enough back so that the vehicles' lights would not reflect on the obstacle. There were two men in the test auto. The driver stated when he could see the obstacle, while the other man dropped a marker at that point. The driver made several test runs, starting with the 10-foot median, then the 20-foot median, and so on, until there was no glare, or until he could clearly observe the obstacle with his headlights alone. A total of seven drivers performed the test.

The results of the first test are summarized in the table below.

This table was prepared from the observations of the seven drivers tested, and shows the minimum safe median widths with high-beam headlights for design speeds from 30 to 70 m.p.h.

The second test was conducted by measuring the light intensity as related to median width and distance from the source. During the test the stationary vehicle remained at station 0 + 00. on the base line with headlights on high-beam while another auto was driven over each 50-foot station on each lane. An illumination reading was taken through the windshield at the same height as the driver's eyes.



Curves were then computed as a measure of source intensity expressed in candle-power by the relation $I=ER^2$, where I= source intensity in candle-power, E=illumination in foot-candles, and R=distance from source in feet. The average curve computed and plotted on the graph for the first test was superimposed upon the light intensity curves as shown on page 47.

It is interesting to note that the superimposed curve which represents the average results of the seven drivers tested follows very closely to the 25,000 candle-power limits of the graph. It is concluded, therefore, that the 25,000 contour of illumination is the safe maximum candle-power against which an opposing automobile can be driven without restricting sight distance as a result of glare.

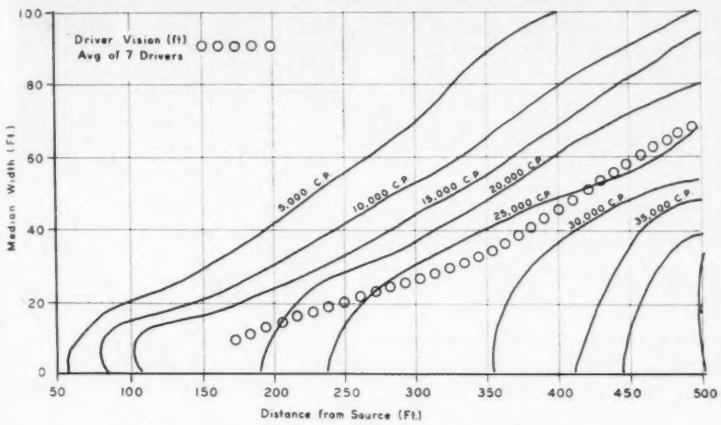
While it is evident that this report required a minimum amount of material and elapsed time, and the procedure is extremely simple, it is believed that the conclusions are indeed valid and useful. Guidance for conducting the field tests and editing of the report was done by Mr. Dean Tisdale, District Design Engineer, Shoshone, Idaho. The test and the report are the direct result of effort expended by Don R. Fries and Ralph T. Gwinn.

MEDIAN WIDTH VS. SIGHT DISTANCE
FOR HIGH BEAM HEADLIGHT OPERATION

DESIGN SPEED (mph)	SAFE STOPPING SIGHT DISTANCE	MIN. MEDIAN WIDTH TO ELIMINATE GLARE
30	200	10-20
40	275	20-30
50	350	30-40
60	475	50-60
70	600	60-80

These results are more effectively portrayed in the graph (Figure 1) which shows the sight distance provided against high beam headlights for varying widths of medians.

Figure II



Source Intensity as a Function of Median Width and Distance from Source

who are Engineers-in-Training with the Idaho Department of Highways. Copies of the complete report can be obtained upon request.

Letters to the Editor

Sir:

The "1957 Proceedings, 27th Annual Meeting, ITE, September, 1957" just received suggested complete lack of interest on the part of traffic engineers in public transportation.

Not one of the 12 speeches included in the "Proceedings" dealt with public transportation — indeed, the subject was not even mentioned with a word in any of them. Every speech dealt, of course, with one phase or another of traffic, but only automobile traffic, as if that was the only traffic there is.

Would it not be well for traffic engineers to take notice of the fact, that there are thousands of people in all the big cities and many of the smaller ones, who depend on public transportation for getting around? Also, that public transportation so far, is the only remedy in sight for the ever increasing congestion?

Men in authority, like mayors and governors, are beginning to realize that the building of more and more expressways will not cure the congestion from which most cities are suffering. Los Angeles is an outstanding example of what can be expected. There they have gone all out for expressways — they call them freeways — but every once in a while some comedian will come out with a joke about them, implying that a motorist expected a free and fast ride but got something quite different. Here in Chicago the completion of the Congress Street Expressway beyond Laramie Avenue is likely to add so much automobile traffic, that while the rapid transit trains in the median strip will glide into the tunnel at Halsted Street without any delay, the automobiles are likely to be backed up a mile.

The people who begin to see that more expressways will not cure their congestion are turning to public transportation for relief; they want to encourage the use of this much more efficient means of moving people by making it more attractive. Now, a business man who finds his business slipping would not confine his efforts to improving his income; he would also try to cut his costs. If we apply this sound business principle to our business of overcoming congestion, we should also try to make automobile travel less attractive.

No doubt a mayor or alderman coming out flatfooted for a plan under which hindrances would be put in the way of automobile travel would have a slim chance of surviving the next election; but it would not be necessary either to go that far. The writer would not favor taking any facilities away from the automobile traffic which it already has, but we could certainly consider to stop lavishing benefits on it for a little while and instead spend some of the money on improvements for public transportation. A small part of the millions — nay, billions—which are being poured out for facilities for automobile travel would go a long way towards moving people by public transportation.

What is there anyway, that entitles a person entering a place, which many others also desire to enter at the same time, to drag in a couple of tons of sheet iron along with sundry amounts of glass and rubber? There are plenty of cases where such practices cannot be tolerated. When you board an airliner, there is a limit to how much of your property you can bring along. If a boy tries to take his bicycle with him in a department store, he will certainly be told to leave it outside. And then there is the story about the CPR hotel in Calgary where they put swinging doors at the main entrance to prevent the cowboys from riding right into the lobby on their horses.

Since the end of the war the number of automobiles and their use has increased to such an extent that this part of the traffic has, in many cases, monopolized the facilities that were intended to serve everybody. When the exclusive transit lane on Washington Street in Chicago's Loop was under consideration, there were those who questioned the propriety of reserving a whole lane for buses (the bus *riders* were not mentioned). The lane is one out of five, or 20% of the street space, but the transit riders constituted 39% of the total eastbound riders. On Madison Street where the same buses leave the Loop, which enter on Washington, there is only room for four lanes, so if an exclusive bus lane were established there, it would reserve 25% of the street space for the transit riders; however, they constituted 53% of the total.

Logically there can be no objection to exclusive transit lanes wherever buses are delayed by congestion. It is always a case of serving the general public in preference to some private individuals, and it is nothing but a further application of the age-old principle of separating various traffic elements. We put the pedestrians on the sidewalk and horses and vehicles on the roadway long before the days of automobiles and public transportation.

Traffic engineers bent on moving people rather than vehicles in orderly and safe manner can hardly afford to ignore public transportation, and the establishing of exclusive bus lanes would go a long way towards making

it more attractive and in turn clear up congestion. Building of rapid transit lines would go much further, but such facilities can only be justified in some of the largest cities, whereas few cities of any size are without bus service.

KAY LORENTZEN
De Leuw, Cather & Co.
Chicago, Ill.
March 14, 1958

Sir:

Mr. Tutt's discussion (TRAFFIC ENGINEERING, March 1958) of the selection of interchange types between two full freeways is particularly timely and important as the tempo of construction of the Interstate System accelerates. Until now, interchanges between two freeways have been rare, as have, indeed, long sections of continuous full freeway in urban areas. But as more of these types of facilities have been placed in operation, certain serious operating problems have begun to be noticeable. Because of this, I am perhaps not in complete agreement with Mr. Tutt.

Traffic on freeways moves at high speeds, and it is important that all decisions required of drivers be simple and reasonably repetitive. Any need for double decisions or "surprises" may become the cause of hesitation and confusion, especially among drivers who are in unfamiliar territory. Mr. Tutt correctly emphasizes in his article the need to spread out the points of decision, and also shows in Figure 1* a layout in which the major traffic stream need make only one decision throughout the interchange. Also, all traffic enters and leaves at the right, which is in accord with what drivers have learned to expect.

However, there would seem to be room for disagreement with Mr. Tutt's evaluation of the relative merits of the four-level type interchange (Figure 10)* and the direct type (Figure 11)*. The disadvantages of the direct type are perhaps more serious than has been stated. The through traffic** must make two decisions rather than one, and there is a practical limit to the distance between the two points of decision. The second decision to be made is a "surprise," since drivers do not generally expect to leave a freeway from the fast (median) lane. The through driver is again surprised at the far end of the interchange by a merging conflict from the left into the fast lane.

Perhaps more critical, especially on 6- and 8-lane freeways, is the weaving problem created by ramps entering and leaving at the median lane. Two main types of weaving problems are created, both of which would be avoided by a four-level interchange. Most heavy commercial vehicles generally travel in the shoulder lane, and are required to weave across intermediate lanes into the fast lane (which then becomes a slow one) to reach the ramp, and a parallel situation exists when they have reached the other freeway and wish to return to the shoulder lane. The second problem is caused by traffic entering a freeway at the last on-ramp prior to the interchange wishing to reach the left turn ramp, or traffic having completed a left turn wishing to leave the freeway by the next off ramp. A glance at charts of required weaving distances — keeping in mind the number of lanes across which the traffic must weave—will make it plain that no nearby ramps could be used by traffic making left turns from one freeway to another. This situation has been the cause of some trouble at the interchange of the Ford and Lodge Expressways in Detroit and has resulted in attempts to prohibit left turning vehicles from heading for the nearest off-ramps.

The direct type interchange, therefore, would seem to be unable to provide traffic service for some desired traffic movements, and less smooth and less safe service to others. This probably results in lowering of speeds throughout the interchange area (I wonder whether this has been surveyed in Detroit or elsewhere?), and the principal advantage of the direct type, namely the higher ramp speeds, would be lost. The four-level type, with its slower ramp speeds because of steeper grades might actually involve no more travel time than the direct type. In rural areas the four-level type can probably be "pulled apart" to permit easier ramp grades. Finally, a cost analysis to compare one four-level structure with sixteen simple separations might become a factor favoring the former type of interchange.

To promote the smooth flow of 6- and 8-lane freeways it would be important to educate drivers properly. One of the most important rules to be instilled is the service offered by each freeway lane. The shoulder lane is most suitably the access and egress lane, as well as the lane for slow moving traffic. Heavy trucks and other slow moving vehicles generally need never use any other lane. The median lane has become known as the fastest lane, to be used by the through driver still far from his intended exit. Direct-type interchanges, and other ramps on and off the median lane, tend to disturb this pattern and to surprise and confuse unfamiliar drivers. They also cause additional and often substantial weaving movements, and perhaps make the use of nearby access ramps impossible for left-turning traffic. The direct interchanges already built should be studied carefully before this type is recommended for general use in the freeway systems we are now building.

Sincerely yours,

WOLFGANG S. HOMBURGER
Assistant Research Engineer
Institute of Transportation and
Traffic Engineering
University of California
March 21, 1958

*References to illustrations are to those in the article by Mr. Tutt in the March issue.

**This argument assumes that through traffic is the major movement. If either turning movement is heavier than the through movement, the entire problem must be restated.

TRAFFIC ENGINEER'S ROLE

(Continued from page 13)

velopments in his profession so does the traffic engineer seek to carry out his responsibilities to protect the safety of his public.

5. The professional decision of the traffic engineer must prevail if safety, through engineering, is to be achieved.

6. The traffic engineer all too often is not in a position to carry out his decisions or to have them prevail.

7. State and local legislation must convey upon the professionals sufficient powers to carry out their decision rather than relying upon legislative procedures.

8. There is a serious shortage of traffic engineers that will continue for several years. Where such are not available, it will be better to rely upon the judgment of a professional man, even though inexperienced in this specialty, than to proceed upon the basis of pressures and politics.

This presentation is based upon over 25 years of experience as a professional traffic engineer embracing work in various parts of the country and covering planning, design, operation, research, and administration. To that extent, this presentation can be considered authoritative. The examples that

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Results provide the best endorsement of Electro-Matic® Radar Speed Meters. Here's how a few newspapers have reported those results when Speed Meters were used locally:

"Radar Cuts road death toll 25%" — *Long Beach, Calif., Ind. Press Telegram.* "Accidents' injuries reduced 22%" — *Cleveland Press.* "Number of cars exceeding 50 miles an hour reduced 50%" — *N.Y. Journal-American.* "Police and court officials feel that radar is superior to other types of speed enforcement because it virtually eliminates human errors." — *Arcadia, Calif., Tribune & News.* "Reduces local traffic deaths by 28%" — *Pasadena, Calif., Star News.* "Psychological effect like magic" — *Pittsburgh Sun-Telegraph.* "Psychological effect of radar has reduced speeding, and that, in turn, has reduced the death toll" — *Belleville, Ill., Advocate.* "Radar machines cost money. But so do funerals. In the long run radar is cheaper." — *Houston Press.* "Nation's top traffic policeman is radar; use is increasing" — *Greenwood, S.C., Index-Journal.*

"Traffic Toll Drop Credited to Radar" — *Buffalo, N.Y., Courier-Express.* "Radar cutting death toll on highways" — *Bridgeport, Conn., Sunday Post.* "Grand Jury urges radar speed control" — *San Jose, Calif., Mercury.* "We've saved 6 lives! Give radar a hand" — *Houston Press.* "Radar credited in accident decrease" — *Lubbock, Texas, Avalanche-Journal.* "Since use of radar highway deaths drop" — *Wichita Falls, Texas, Daily Times.* "Oregon motorists favor the use of radar in speed detection by ratio of three to one" — *Eugene, Oregon, Register Guard.* "Most effective means of stopping slaughter on the highways" — *Atlantic City, N.J., Press.*

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TRAFFIC ACTUATED

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I gave are only a few of those available. Traffic engineers throughout the country have done exceptionally well under circumstances which have often been most difficult, in providing safer, more convenient, more economical transportation.

We traffic engineers take pride in our profession and our achievements. We look forward to greater and better accomplishments as we march ahead with our professional counterparts and enforcement towards greater safety for pedestrians and motorists in this great land of ours.

County Roads

At the ARBA County Division Convention in French Lick, Indiana last October, A. E. Johnson, Executive Secretary, AASHO, said: "Out of 3047 counties, about 2800 have road responsibilities. Approximately 850 have highway engineers. Local rural governmental units have control of over 70 per cent of the Nation's 3.4 million miles of public roads and streets, but this 70 per cent carries only 15 per cent of all rural and 8 per cent of the total motor travel. About 90 per cent of all local rural roads carry less than 100 vehicles per day. Approximately 45 per cent of the total of local rural roads are primitive, graded and non-surfaced facilities. Only 11 per cent have intermediate or high type surfacing. The counties employ 620,000 people with a monthly payroll of $160 million. They spend $3.25 billion per year for goods and services of all types."

Urban Signing

Ben Petty of Purdue comments on a recent motor trip:

The more we travel by automobile, the more I am convinced that the poorest job of state highway signing is on routes through cities. And I certainly am not neglecting Indiana on this score. Daniel Boone or Kit Carson would get lost on state highway routes through scores of our U. S. cities. Time after time in trying to follow a certain state route through a city on multi-laned streets we find ourselves in the center lane where the route turns right, or in the outer lane where the route turns left and are forced to continue on a block or two then try to get back on the right track. No advance warning of a turn! Correcting this one defect would keep our traffic boys busy for months or years to come.

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Aluminum Company of America
Alcoa Building Pittsburgh 19, Pa.
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American Transit Association
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Automatic Signal Division Eastern Industries, Inc.
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Paul L. Green, Representative

California Metal Enameling Company
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Standish K. Penton, Representative

Cataphote Corporation
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Wm. J. Larkin (P.O. Box 2066, Jackson, Miss.) Representative

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Don Martin, Representative

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	1957	1956	1955	1957	1956	1955	1957	1956	1955	1957	1956	1955	1957	1956	1955	1957	1956	1955	1957	1956	1955	1957
Colorado Dept. of Highways Denver-Boulder Turnpike	34.5	--	--	33	--	--	10	--	--	1	--	--	1	--	--	95.6	--	--	2.9	--	--	4.3(7)
Connecticut State Hwy. Dept. Merritt-Wilbur Cross Pkwys.	Not yet available	679.5	653		1266	1201		555	528		16	18		20	19		186.3	184.0		2.9	2.9	3.0(10)
Florida State Turnpike Auth. Sunshine State Parkway (See Note A)	151.	--	--	235	--	--	124	--	--	2	--	--	3	--	--	156.	--	--	2.5	--	--	5.6(10)
Indiana Toll Road Commission Indiana East-West Toll Rd. (See Note B)	522.	112.3	--	625	180	--	142	38	--	14	4	--	14	6	--	119.7	160.0	--	2.6	5.3	--	5.6(10)
Kansas Turnpike Authority Kansas Turnpike	217.	36.0	--	253	47	--	92	12	--	10	1	--	13	1	--	116.	131.0	--	5.9	2.8	--	5.8(9)
Kentucky State Hwy. Dept. Kentucky Turnpike	Not yet available	6.2	--		20	--		8	--		1	--		1	--		3.2	--		0.2	--	7.7(10)
Maine Turnpike Authority Maine Turnpike & Ext.	195.2	186.7	100.5	250	329	116	95	83	48	4	7	6	4	8	7	128.	176.0	115.0	2.1	4.3	7.0	3.5(10)
Massachusetts Turnpike Auth. Massachusetts Turnpike (See Notes B & C)	306.2	--	--	408	--	--	126	--	--	10	--	--	10	--	--	133.3	--	--	3.3	--	--	3.1(10)
New Hamp. State Hwy. Dept. New Hampshire Turnpike	62.1	55.8	50.2	52	69	62	20	47	45	0	0	1	0	0	1	83.7	124.0	124.0	0.0	0.0	2.0	4.0(10)
New Jersey Highway Authority Garden State Parkway	1448.	996.9	808.6	942	689	471	305	540	204	14	12	10	19	13	10	65.1	69.1	58.2	1.3	1.3	1.2	3.5(10)
New Jersey Turnpike Auth. New Jersey Turnpike	1206.	1070.0	942.0	1045	1009	1145	385	287	312	20	18	25	24	25	26	86.6	94.0	122.0	2.0	2.3	2.8	3.5(10)
N. Y. State Thruway Auth. New York State Thruway (See Note B)	1700.5	1418.7	918.5	3251	2831	2010	407	445	340	31	33	24	33	38	26	191.2	199.5	218.8	1.9	2.7	2.8	4.6(10)
Ohio Turnpike Commission Ohio Turnpike (See Note E)	909.7	786.4	198.5	773	1097	375	280	262	93	22	14	6	28	15	6	85.0	139.5	188.9	3.1	1.9	3.0	5.3(10)
Oklahoma Turnpike Auth. Turner Turnpike	153.0	142.5	137.5	108	110	122	27	37	39	3	4	8	4	4	12	70.6	77.2	88.7	2.6	2.8	8.7	6.7(8)
Oklahoma Turnpike Auth. Will Rogers Turnpike (See Note F)	52.7	--	--	34	--	--	10	--	--	3	--	--	3	--	--	65.8	--	--	5.7	--	--	6.7(8)
Pennsylvania Turnpike Comm. Pennsylvania Turnpike (See Notes B & G)	1854.	1619.4	1415.9	1930	1651	1652	563	584	571	48	56	65	62	74	90	104.1	101.9	116.7	3.3	4.6	6.4	4.3(9)
Westchester Co. Park Comm. Hutchinson River, Cross Co., Saw Mill River Parkways	Not yet available	704.8	696.8		1939	1875		499	402		21	14		28	17		275.1	269.1		4.0	2.4	4.6(10)
West Va. Turnpike Comm. West Virginia Turnpike (See Note H)	100.0	94.0	89.5	149	152	197	139	43	45	10	5	10	14	8	12	149.	161.7	220.1	14.0	8.5	13.4	7.8(5)
TOTAL TURNPIKES	8911.9	7909.2	6011.0	10088	11389	9226	2725	3440	2627	192	192	187	232	241	226	113.3	144.0	153.5	2.6	3.0	3.8	-
TOTAL U. S. A. (See Note I)	650,000	628,381	583,006										38,500	39,628	38,426				5.9	6.3	6.6	5.9(12)

Notes: A—Sunshine State Parkway: January 25, 1957 to December 31, 1957.
B—Accident rate is based on all accidents regardless of amount of damage.
C—Massachusetts Turnpike: May 16, 1957 to December 31, 1957.
D—State Fatality Rate not available for all 1957. Figures in parentheses indicate number of months covered.
E—Includes all accidents including incidents and minor ones in 1956; in 1957, does not include property damage accidents of less than $100.
F—Will Rogers Turnpike: June 28, 1957 to December 31, 1957.
G—Vehicle Miles = actual for 11 mos.; estimated for December 1957.
H—Total Accidents = accidents involving damage of at least $100.
I—TOTAL U.S.A.: Figures from estimates of the National Safety Council and the Automobile Manufacturers Association.

Based on survey by American Bridge, Tunnel and Turnpike Association, Inc., February, 1958.

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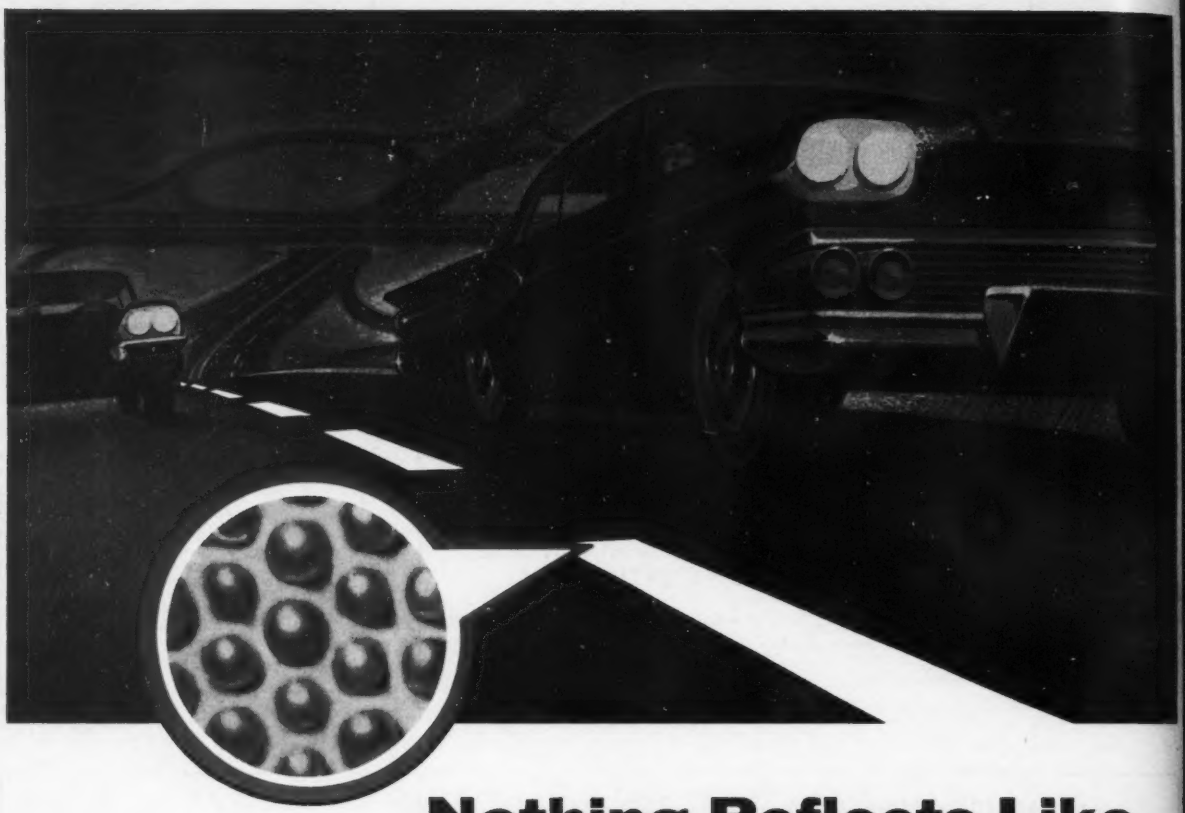

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